



CANADA

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THE
SCIENTIFIC AMERICAN
REFERENCE BOOK.

A COMPENDIUM OF
USEFUL INFORMATION.

CONTAINING THE COMPLETE CENSUS OF THE UNITED STATES BY
COUNTIES; MAP OF THE UNITED STATES; VIEWS OF PUBLIC
BUILDINGS; PATENT AND COPYRIGHT LAWS; RULES AND
DIRECTIONS FOR OBTAINING PATENTS; FORMS FOR PA-
TENTS, CAVEATS, ASSIGNMENTS, AND LICENSES;
HINTS ON THE VALUE AND SALE OF PATENTS;
TABLES OF THE WEIGHTS AND MEASURES
OF THE UNITED STATES; THE PRIN-
CIPAL MECHANICAL MOVEMENTS,
WITH 150 DIAGRAMS; HISTORY
AND DESCRIPTION OF THE
STEAM-ENGINE, AND
VALUABLE TABLES,
CALCULATIONS,
PROBLEMS,
ETC.

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1877.

CENSUS

OF THE

UNITED STATES, BY COUNTIES, FOR 1870.

ALABAMA.—Area, 50,722 square miles.

Autauga...11,623	Clay...9,560	Fayette...7,166	Lowndes...25,719	Randolph...12,006
Baker...6,194	Cleburne...8,017	Franklin...8,006	Macon...17,727	Russell...21,636
Baldwin...6,004	Coffee...6,171	Geneva...2,959	Madison...31,267	Sanford...8,893
Barbour...29,309	Colbert...12,537	Greene...18,399	Marengo...26,151	Shelby...12,218
Benton...7,469	Conecuh...9,574	Hancock...21,592	Marion...6,069	St. Clair...9,360
Bibb...9,945	Coosa...11,945	Hale...14,191	Marshall...9,871	Sumter...24,110
Blount...24,474	Covington...4,868	Henry...19,410	Mobile...49,311	Talladega...18,063
Bullock...14,981	Crenshaw...11,156	Jackson...12,345	Montgomery...43,704	Tallapoosa...16,963
Calhoun...13,979	Dale...11,325	Jefferson...12,345	Morgan...12,187	Tuscaloosa...20,081
Chambers...17,562	Dallas...40,705	Lauderdale...15,092	Monroe...14,214	Walker...6,543
Cherokee...11,132	De Kalb...7,126	Lawrence...16,658	Perry...24,975	Washington...3,912
Choctaw...12,676	Elmore...14,477	Lee...21,750	Pickens...17,690	Wilcox...28,377
Clark...14,629	Escambia...4,041	Limestone...15,017	Pike...17,423	Winston...4,155
	Etowah...10,109	Total...		996,988

ARKANSAS.—Area, 52,198 square miles.

Arkansas...8,268	Craighead...4,577	Izard...8,806	Newton...3,364	Saline...3,911
Ashley...8,042	Cross...3,915	Jackson...7,268	Ouachita...12,975	Scott...7,483
Benton...13,831	Dallas...5,707	Jefferson...15,733	Perry...2,685	Searcy...5,614
Boone...7,032	Desha...6,125	Johnson...9,152	Phillips...15,372	Sebastian...12,940
Bradley...8,646	Drew...9,960	Lafayette...9,139	Pike...3,788	Sevier...4,492
Calhoun...8,853	Franklin...9,627	Lawrence...6,981	Poinsett...1,720	Sharpe...5,400
Carroll...5,780	Fulton...4,843	Little River...3,236	Polk...3,376	Union...10,571
Chicot...7,214	Grant...3,943	Madison...7,927	Pope...8,409	Van Buren...5,107
Clark...11,953	Green...7,573	Marion...8,979	Prairie...5,604	Washington...17,266
Columbia...11,397	Hempstead...13,768	Mississippi...8,633	Pulaski...32,066	White...10,346
Conway...8,112	Hot Springs...5,877	Monroe...8,336	Randolph...7,466	Woodruff...6,891
Crawford...8,957	Independence...14,566	Montgomery...2,984	St. Francis...6,714	Yell...8,048
Crittenden...8,831	Total...			488,179

CALIFORNIA.—Area, 188,981 square miles.

Alameda...24,237	Humboldt...6,143	Merced...2,807	S. Francisco...149,482	Solano...16,871
Alpine...685	Inyo...1,956	Mono...430	S. Joaquin...21,050	Sonoma...19,119
Amador...9,582	Kern...2,925	Monterey...9,876	S. Luis Obispo...4,772	Stanislaus...6,499
Butte...11,403	Klamath...1,686	Napa...7,163	S. Mateo...6,635	Sutter...5,030
Calaveras...8,895	Lake...2,969	Nevada...19,136	S. Barbara...7,784	Tehoma...3,587
Colusa...6,165	Lassen...1,324	Placer...11,357	S. Clara...26,246	Trinity...3,213
Contra Costa...8,461	Los Angeles...15,309	Plumas...4,489	S. Cruz...8,743	Tulare...4,533
Del Norte...2,022	Marin...6,903	Sacramento...26,831	Shasta...4,173	Tuolumne...8,150
El Dorado...10,309	Mariposa...4,572	S. Bernar's...3,988	Sierra...5,619	Yolo...9,899
Fresno...6,336	Mendocino...7,545	San Diego...4,974	Siakiyou...6,848	Yuba...10,851
	Total...			560,285

CONNECTICUT.—Area, 4,674 square miles.

Fairfield...95,276	Litchfield...48,727	N. Haven...121,257	Tolland...22,000	Windham...38,518
Hartford...109,007	Middlesex...36,099	N. London...66,534	Total...	537,418

DELAWARE.—Area, 2,120 square miles.

Kent...29,804	N. Castle...63,515	Sussex...31,696	Total...	125,015
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FLORIDA.—Area, 59,268 square miles.

Alachua...17,328	Duval...11,921	Jackson...9,528	Marion...10,804	St. Johns...2,618
Baker...1,325	Escambia...7,825	Jefferson...13,396	Monroe...5,657	Sumter...2,952
Benton...4,973	Franklin...1,255	Lafayette...1,783	Nassau...4,247	Suwanee...3,556
Bradford...3,671	Gadsden...9,802	Leon...15,233	New River...1,443	Taylor...1,423
Brevard...1,216	Hamilton...5,749	Levy...2,017	Orange...2,195	Volusia...1,723
Calhoun...908	Hernando...2,938	Liberty...1,050	Polk...3,159	Wakulla...2,505
Clay...2,098	Hillsboro...3,215	Madison...11,121	Putnam...3,821	Walton...3,050
Columbia...7,335	Holmes...1,572	Manatee...1,931	S. Rosa...3,312	Washington...2,302
Dade...85	Total...			187,750

GEORGIA.—Area, 58,000 square miles.

Appling...5,086	Bullock...5,610	Charlton...1,897	Cobb...13,814	De Kalb...10,014
Baker...6,843	Burke...14,585	Chatham...41,279	Coffee...3,192	Dooley...9,790
Baldwin...10,618	Butts...6,941	Chattahoochee...6,059	Colquitt...1,654	Dougherty...11,514
Banks...4,973	Calhoun...8,503	Chattooga...6,902	Columbia...13,529	Early...8,958
Bartow...16,566	Camden...4,611	Cherokee...10,399	Coweta...15,875	Echols...1,978
Berrien...4,518	Campbell...9,176	Clarke...12,941	Crawford...7,567	Effingham...4,214
Bibb...21,255	Carroll...11,782	Clay...5,493	Dade...3,033	Elbert...9,249
Brooks...8,343	Cass...5,477	Clayton...4,369	Dawson...4,369	Emanuel...6,143
Bryan...5,252	Catoosa...4,400	Clinch...3,945	Decatur...15,183	Fannin...5,429

CENSUS OF THE UNITED STATES.

Fayette	8,221	Henry	10,102	Kerriwet'r	13,756	Quitman	4,150	Troup	17,632
Floyd	17,230	Houston	20,406	Miller	3,091	Rabus	3,266	Twiggs	8,545
Forayth	7,983	Irwin	1,837	Milton	4,284	Randolph	10,561	Union	5,267
Franklin	7,893	Jackson	11,181	Mitchell	6,633	Richmond	25,137	Upson	9,430
Fulton	3,346	Jasper	10,439	Monroe	17,213	Schley	5,129	Walker	9,978
Gilmer	6,644	Jefferson	12,192	Montgom'y	3,885	Scriven	9,175	Walton	11,038
Glascock	2,736	Johnson	2,964	Morgan	10,696	Spaulding	10,205	Ware	2,386
Glynn	5,376	Jones	9,436	Murray	6,500	Stewart	14,204	Warren	10,545
Gordon	9,268	Laurens	7,834	Muscogee	16,663	Sumter	16,559	Washing'n	15,641
Greene	12,464	Lee	9,567	Newton	14,615	Talbot	11,913	Wayne	2,127
Gwinnett	12,431	Liberty	18,913	Oglethorpe	11,783	Tallaferro	4,796	Webster	4,677
Habersham	6,322	Lincoln	5,413	Paulding	7,639	Tatnall	4,960	White	4,606
Hall	9,607	Lowndes	8,321	Pickens	5,317	Taylor	7,143	Whitfield	10,117
Hancock	11,317	Lumpkin	5,161	Pierce	2,778	Telfair	3,245	Wilcox	2,439
Haralson	4,004	Macon	11,448	Pike	10,905	Terrell	9,053	Wilkes	11,796
Harris	13,284	Madison	6,227	Polk	7,822	Thomas	17,158	Wilkinson	9,387
Hart	6,783	Marion	8,300	Pulaski	11,540	Towns	2,780	Worth	3,778
Heard	7,866	McIntosh	4,485	Putnam	10,461	Total			1,194,069

ILLINOIS.—Area, 55,405 square miles.

Adams	55,392	Du Page	16,685	Jo Daviess	27,810	Mason	16,184	Sallie	12,714
Alexander	10,564	Edgar	21,460	Johnson	11,248	Massac	9,581	Sangamon	46,354
Bond	13,152	Edward	7,565	Kane	39,091	Menard	11,735	Schuyler	17,419
Boone	12,942	Effingham	15,653	Kankakee	24,352	Merced	18,769	Scott	10,530
Brown	12,205	Fayette	19,336	Kendall	12,399	Monroe	12,892	Shelby	25,475
Bureau	32,415	Ford	9,103	Knox	39,523	Montgom'y	25,315	Stark	10,751
Calhoun	6,562	Franklin	12,652	Lake	21,014	Morgan	28,463	Stephenson	30,608
Carroll	16,705	Fulton	33,292	La Salle	60,792	Moultrie	10,385	Tazewell	27,903
Cass	10,069	Gallatin	11,134	Lawrence	12,533	Ogle	27,493	Union	15,518
Champaign	32,738	Green	20,277	Lee	27,171	Peoria	47,540	Vermilion	30,388
Christian	20,363	Grundy	14,938	Livingston	31,472	Perry	13,723	Wabash	8,841
Clark	18,710	Hamilton	13,014	Logan	23,052	Piatt	10,953	Warren	23,174
Clay	15,875	Hancock	34,461	McDono'h	26,511	Pike	30,768	Washington	17,590
Clinton	16,284	Hardin	5,113	McHenry	23,762	Pope	11,437	Wayne	19,758
Coles	25,237	Henderson	12,582	McLean	53,968	Pulaski	8,752	White	16,446
Cook	349,979	Henry	25,507	Macoupin	20,622	Putnam	66,260	Whiteside	27,506
Crawford	15,889	Ingham	25,782	Macoupin	32,722	Randolph	20,859	Will	43,013
Cumberland	12,223	Jackson	19,634	Madison	44,131	Richland	12,803	Williamson	17,322
De Kalb	23,265	Jasper	11,234	Marion	20,622	Rock Island	29,783	Winnebago	29,301
De Witt	14,768	Jefferson	17,864	Marshall	16,956	St. Clair	51,069	Woodford	18,966
Douglas	13,484	Jersey	15,054	Total					2,539,688

INDIANA.—Area, 33,809 square miles.

Adams	10,382	Elkhart	26,026	Jefferson	29,741	Noble	20,389	Stark	3,888
Allen	43,494	Fayette	10,476	Jennings	16,218	Ohio	5,837	Steuben	12,854
Barthol'w	21,133	Floyd	23,300	Johnson	18,366	Orange	13,497	Sullivan	18,453
Benton	5,615	Fountain	16,389	Knox	21,559	Owen	16,137	Switzerland	12,134
Blackford	6,272	Franklin	20,223	Kosciusko	23,531	Parke	18,166	Tipton	33,515
Boone	22,593	Fulton	12,726	La Grange	14,148	Perry	14,801	Tipton	11,953
Brown	5,681	Gibson	17,371	Lake	12,330	Pike	13,779	Union	6,341
Carroll	16,152	Grant	18,487	La Porte	27,062	Porter	13,943	Vanderb'g	33,145
Cass	24,193	Green	19,514	Lawrence	14,628	Posey	19,165	Vermilion	10,840
Clarke	24,770	Hamilton	20,882	Madison	22,770	Pulaski	7,802	Vigo	33,549
Clay	19,084	Hancock	15,123	Marion	65,245	Putnam	21,514	Wabash	21,305
Clinton	17,330	Harrison	19,913	Marshall	20,211	Randolph	22,862	Warren	10,204
Crawford	9,851	Hendricks	20,277	Martin	11,103	Ripley	20,977	Warwick	
Daviess	16,747	Henry	22,986	Miami	21,052	Rush	17,626	Washington	18,495
Dearborn	24,116	Howard	15,847	Monroe	14,168	St. Joseph	25,322	Wayne	34,048
Decatur		Huntington	19,036	Montgom'y	25,765	Scott	7,873	Wells	12,585
De Kalb	17,167	Jackson	18,974	Morgan	17,528	Shelby	21,892	White	10,554
Delaware	19,030	Jasper	6,534	Newton	5,829	Spencer	12,998	Whitley	14,269
Dubois	12,597	Jay	15,000						

IOWA.—Area, 50,914 square miles.

Adair	3,962	Cedar	19,731	Dubuque	35,969	Humboldt	2,896	Madison	16,854
Adams	4,614	Cerro Gor'o	4,722	Emmett	1,292	Iowa	226	Mahaska	2,508
Allamakee	17,868	Cherokee	1,967	Fayette	16,973	Jackson	22,620	Marion	4,434
Appanoose	16,458	Chickasaw	10,180	Floyd	10,768	Jackson	22,620	Marshall	17,076
Audubon	1,212	Clarke	8,735	Franklin	4,738	Jasper	22,116	Mills	8,717
Benton	22,454	Clay	1,523	Freemont	11,174	Jefferson	17,839	Mitchell	9,583
Bl'k Hawk	21,706	Clinton	27,771	Greene	4,527	Johnson	24,858	Monona	2,654
Boone	14,576	Crawford	25,357	Grundy	6,398	Jones	19,731	Montgomery	12,724
Bremer	12,528	Dallas	2,530	Guthrie	7,061	Keokuk	19,434	Montgom'y	5,934
Buchanan	17,034	Davis	12,019	Hamilton	6,065	Kossuth	3,351	Muscatine	21,688
Buena Vista	1,585	Decatur	15,565	Hancock	999	Lee	37,210	O'Brien	716
Butler	9,951	Delaware	12,018	Hardin	13,686	Lynn	26,755	Osceola	
Calhoun	1,802	Des Moines	17,432	Harrison	8,931	Louis	12,860	Page	9,974
Carroll	2,451	Dickinson	1,389	Howard	21,460	Lucas	10,288	Palo Alto	1,336
Cass	5,464				6,282	Lyon	21	Plymouth	2,199

Pocahontas. 1,440	Sac. 1,411	Tama. 16,131	Warren. 17,982	Winneshek. 23,570
Polk. 27,857	Scott. 33,599	Taylor. 6,980	Washington. 18,952	Woodbury. 6,252
Pottawatt. 16,893	Shelby. 2,546	Union. 5,986	Wayne. 11,267	Worth. 2,892
Poweshiek. 18,581	Sioux. 876	Van Buren. 17,672	Webster. 10,484	Wright. 2,392
Ringgold. 5,693	Story. 11,651	Wapello. 22,346	Winnebago. 1,562	Total. 1,191,902

KANSAS.—Area, 78,418 square miles.

Allen. 7,023	Crawford. 5,160	Jefferson. 12,526	Nemaha. 7,339	Rush. 156
Anderson. 5,220	Davis. 3,993	Jewell. 207	Ness. 2	Russell. 156
Atchison. 15,507	Dickinson. 3,043	Johnson. 13,684	Neosho. 10,206	Saline. 4,246
Barber (w. Carley) 2	Doniphan. 19,969	Kiowa. 9,973	Norton. 33	Sedgwick. 1,522
Barton. 2	Douglas. 20,604	Labette. 516	Oaage. 2,127	Shawnee. 13,121
Bourbon. 15,076	Ellis. 1,336	Leavenworth. 32,444	Osborne. 33	Smith. 66
Brown. 6,824	Ellsworth. 1,185	Lincoln. 12,174	Ottawa. 179	Stafford. 166
Butler. 3,035	Ford. 8,024	Linn. 768	Pawnee. 179	Sumner. 166
Chase. 1,975	Franklin. 10,385	Lyon. 6,901	Phillips. 7,948	Trego. 166
Cherokee. 11,038	Graham. 3,484	Marion. 738	Pottawatt. 7,948	W. Lawrence. 3,892
Clarke. 2,943	Greenwood. 3,484	Marshall. 738	Pratt. 1,281	Wallace. 538
Clay. 2,943	Gove. 1,172	McPherson. 738	Republic. 1,281	Washington. 4,081
Cloud. 2,323	Harp (w. Carley) 1,172	Miami. 485	Reno. 5	Wilson. 6,694
Coffee. 6,201	Hodgeman. 2,794	Mitchell. 2,225	Rice. 5,105	Woodson. 3,827
Comanche. 1,175	Howard. 6,053	Montgomery. 2,225	Riley. 5,105	Wyandott. 10,019
Carley et al. 1,175	Jackson. 6,053	Morris. 2,225	Rorke. 362,873	Total. 362,873

KENTUCKY.—Area, 37,680 square miles.

Adair. 11,065	Clay. 8,297	Harrison. 12,993	Madison. 19,543	Pike. 9,562
Allen. 10,296	Clinton. 6,497	Hart. 13,687	Magoffin. 4,684	Powell. 2,599
Anderson. 5,449	Crittenden. 9,381	Henderson. 18,457	Marion. 12,838	Pulaski. 17,670
Ballard. 12,576	Cumlerd. 7,690	Henry. 11,066	Marshall. 9,465	Robertson. 63,069
Barren. 17,780	Daviess. 20,714	Hickman. 8,453	Mason. 18,126	Rock Castle. 7,145
Bath. 10,145	Edmondson. 4,459	Hopkins. 13,827	McCracken. 13,988	Rowan. 2,991
Boone. 10,696	Elliott. 4,433	Jackson. 4,547	McLean. 7,614	Russell. 5,609
Bourbon. 14,863	Estill. 9,198	Jefferson. 118,953	Mende. 9,485	Scott. 11,407
Boyd. 8,573	Fayette. 20,656	Jessamine. 8,638	Menifee. 1,866	Shelby. 15,733
Boyle. 9,815	Fleming. 13,358	John Bell. 2,731	Mercer. 13,144	Simpson. 9,573
Bracken. 11,409	Floyd. 7,877	Johnson. 7,494	Metcalfe. 7,534	Spencer. 8,586
Breathitt. 6,672	Franklin. 15,300	Kenton. 36,096	Monroe. 9,231	Taylor. 8,226
Breckinridge. 13,440	Fulton. 6,161	Knox. 8,294	Montgomery. 7,587	Todd. 12,612
Bullitt. 7,781	Gallatin. 5,074	La Rue. 8,235	Morgan. 8,975	Trigg. 13,686
Butler. 9,404	Garrard. 10,376	Laurel. 6,016	Muhlenberg. 12,638	Trimble. 5,577
Caldwell. 10,826	Grant. 9,629	Lawrence. 8,497	Nelson. 14,804	Union. 13,640
Calloway. 9,400	Graves. 19,398	Lee. 3,055	Nicholas. 9,129	Warren. 21,742
Campbell. 27,406	Grayson. 11,580	Letcher. 4,608	Ohio. 15,561	Washington. 12,464
Carroll. 6,189	Greene. 9,379	Lewis. 9,115	Oldham. 9,027	Wayne. 10,602
Carter. 7,505	Greenup. 11,463	Lincoln. 10,947	Owen. 14,309	Webster. 10,937
Casey. 8,894	Hancock. 6,591	Livingston. 8,200	Owsley. 8,889	Whiteley. 8,378
Christian. 23,227	Hardin. 15,705	Logan. 20,429	Pendleton. 14,030	Wolfe. 3,603
Clark. 10,892	Harlan. 4,415	Lyon. 6,233	Perry. 4,274	Woodford. 8,240
Total. 1,321,001				

LOUISIANA.—Area, 41,255 square miles.

Ascension. 11,577	Carroll. 10,110	Jackson. 7,646	Plaquemine. 10,553	S. Martin's. 9,370
Assumption. 13,284	Catahoula. 8,475	Jofferson. 17,767	Pt. Coupee. 12,981	St. Mary's. 13,860
Atoyelles. 12,926	Cimbarne. 20,240	Lafayette. 10,388	Rapides. 18,015	St. Tammy. 5,583
B. Roux. E. 17,817	Concordia. 9,977	Lafourche. 14,719	Richland. 5,110	Tangipahoe. 7,928
B. Roux. W. 5,114	De Soto. 14,962	Livingston. 4,028	Sabine. 6,466	Tensas. 12,427
Bienville. 10,630	Felice'n. E. 13,499	Madison. 9,387	S. Bernard. 3,553	Ter. Bonne. 12,451
Bossier. 12,675	Felice'n. W. 10,496	Moorehouse. 9,387	St. Charles. 4,867	Union. 11,683
Caddo. 21,714	Franklin. 5,076	Natchitoches. 18,265	St. Helena. 4,423	Vermilion. 4,528
Calcasieu. 6,733	Grant. 4,511	Opelousas. 191,425	St. James. 10,153	Washington. 2,330
Caldwell. 4,820	Iberia. 9,042	Orleans. 11,552	S. J. the B'p. 24,646	Winn. 4,955
Cameron. 1,591	Iberville. 12,347	Onachita. 11,552	S. Landry. 24,646	Total. 732,731

MAINE.—Area, 31,766 square miles.

Androsco. 35,885	Hancock. 36,470	Lincoln. 25,597	Piscataquis. 14,403	Waldo. 34,535
Aroostook. 29,609	Kennebec. 53,205	Oxford. 33,486	Sagadahoc. 18,893	Washington. 43,343
Cumberland. 89,920	Knox. 30,622	Penobscot. 34,611	Somerset. 18,190	York. 60,174
Franklin. 16,807	Total. 626,463			

MARYLAND.—Area, 11,124 square miles.

Alleghany. 38,538	Carroll. 23,619	Harford. 22,605	Pr. George. 21,138	Talbot. 16,187
A. Arundel. 24,457	Cecil. 28,874	Howard. 14,150	Qu'n Anne. 16,083	Washington. 34,712
Baltimore. 330,741	Charles. 18,438	Kent. 17,102	St. Mary's. 14,944	Wicomico. 15,802
Calvert. 9,865	Dorchester. 19,455	Montgomery. 20,565	Somerset. 18,190	Worcester. 16,419
Caroline. 12,101	Frederick. 47,572	Total. 780,806		

MASSACHUSETTS.—Area, 7,800 square miles.

Barnstable. 32,774	Dukes. 3,787	Hampden. 78,405	Nantucket. 4,123	Suffolk. 270,802
Berkshire. 64,827	Essex. 200,843	Hampshire. 44,386	Norfolk. 89,443	Worcester. 192,716
Bristol. 102,866	Franklin. 32,635	Niddlesex. 274,353	Plymouth. 65,365	Total. 1,457,351

CENSUS OF THE UNITED STATES.

MICHIGAN.—Area, 56,243 square miles.

Algona	32,105	Gravord	2,441	Kalamazoo	23,054	McGonnine	1,894	Osgood	26,681
Alpena	2,758	Eaton	25,171	Kalamazoo	424	Mich'l's bae.		Ottawa	36,681
Antrim	1,385	Emmett	1,211	Kent	50,403	Midland	4,728	Presq. Isle	385
Barry	22,190	Genesee	33,900	Keweenaw	4,206	Missaukee	130	Rosecommon	
Bay	15,900	Gladwin		Lake	549	Munroe	37,483	Saginaw	39,097
Benzie	2,184	G'd Trave's	4,443	Lapeer	21,245	Montcalm	18,029	St. Clair	36,661
Berrien	55,104	Gratiot	11,810	Leelanaw	4,816	Montmorency		Sanilac	14,569
Branch	26,226	Hilldale	31,684	Leewards	45,596	Muskegon	14,894	Schoolcraft	
Calhoun	36,569	Houghton	13,879	Livingston	19,336	Newaygo	7,398	Shiawassee	20,658
Cass	21,094	Huron	9,049	Mackinaw	1,716	Nicosta		St. Joseph	26,276
Charlevoix	1,724	Ingham	25,259	Macomb	27,616	Oakland	40,867	Tuscola	13,714
Chippewyan	2,198	Ionia	27,631	Manitou	891	Oceana	7,229	Van Buren	28,828
Chippewa	1,683	Iscos	3,163	Manistee	6,074	Ogemaw	12	Washtenaw	41,434
Clare	866	Isabell	4,118	Marquette	15,033	Onondaga	2,845	Wayne	119,039
Climax	22,845	Jackson	36,047	Mason	3,273	Oscoda	2,093	Wessford	650
				Necosta	5,642	Oseola	70	Total	1,184,226

MINNESOTA.—Area, 95,274 square miles

Altken	18	Cottowood	634	Kennebec	93	Ottawa Tail	Sibley	6,725	
Anoka	3,940	Crow Wing	200	Lake	135	Pembina	64	Stearns	14,206
Becker	805	Dakota		L. qui Parl	145	Pierce		Steele	8,271
Belltraine	80	Dodge	8,558	Le Sueur	11,607	Pine	648	Stevens	
Benton	1,558	Douglas et al	4579	McLeod	51,643	Pipe Stone		Todd	
Big Stone	24	Fairbault	9,390	Manomlin		Polk		Toombs	
Blue Earth	17,302	Fillmore	24,857	Martin	13,867	Pope et al	2,575	Traverse	
Breckin's		Freeborn	10,583	Meeker	6,090	Ramsey	23,081	Wabasha	15,550
Brown	6,363	Goodhue	22,618	Mills Lac.	1,109	Redwood	1,329	Wadena	6
Buchanan		Grant		Monongalia	3,161	Renville		Waseca	7,854
Carlton	286	Hennepin	31,566	Morrison	1,869	Rice	10,563	Washington	11,810
Carver	11,557	Houston	11,601	Mower	10,447	Rock	2,152	Watonswan	2,426
Cass	184	Isanti		Murray	209	St. Louis	11,561	Wilko	295
Chippewa	1,467	Itasca	178	Nicoll	8362	Scott	11,042	Winona	22,318
Chicago	4,358	Jackson	1,825	Noble	117	Sherburne	2,650	Wright	9,487
Clay	92	Kandiyohi	1,760	Olmsted	19,793	Total			436,611

MISSISSIPPI.—Area, 47,156 square miles

Adams	14,774	Covington	4,753	Jefferson	13,848	Monroe	22,632	Smith	7,136
Alcorn	10,431	De Soto		Jones	8,313	Neshoba		Sunflower	
Amite		Franklin	7,406	Kemper		Newton	9,807	Tallahatchie	7,852
Attala		Greene	2,038	Lafayette		Noxubee	20,905	Tippah	20,727
Bolivar	9,733	Grenada	10,571	Lauderdale	13,462	Okfuskee		Tiempo	
Calhoun	10,561	Hancock	4,239	Lawrence	6,720	Panola	12,412	Tunica	5,358
Carroll	21,047	Harrison	5,795	Leake		Perry	2,694	Warren	26,765
Chickasaw	19,899	Hinds	26,796	Lee	15,935	Pike	11,368	Washington	14,569
Choctaw		Holmes	19,370	Lincoln	10,184	Pontotoc		Wayne	4,206
Claiborne	13,398	Issaquena	6,887	Lowndes	30,502	Prentiss	9,347	Wilkinson	
Clark	7,505	Itawamba	7,812	Madison	20,943	Rankin	12,977	Winston	8,284
Coahoma	7,144	Jackson	3,362	Marion	4,211	Scott	7,948	Yalabusha	13,954
Copiah	20,608	Jasper	10,884	Marshall	29,410	Simpson	6,718	Yazoo	
		Total							627,117

MISSOURI—Area, 67,380 square miles.

Adair	11,449	Clay	15,564	Iron	6,278	Montgomery	10,405	St. Clair	6,742
Andrew	15,187	Clinton	14,083	Jackson	58,041	Morgan	8,438	St. Francois	9,741
Atchison	8,440	Cole	10,292	Jasper	14,929	N. Madrid	11,339	Ste. Gen'v	8,384
Audrain	12,307	Cooper	20,692	Jefferson	15,380	Newton	12,921	St. Louis	351,190
Barry	10,373	Crawford	7,983	Johnson	24,649	Nodaway	14,781	Saline	21,690
Barton	5,087	Dade	8,683	Knox	10,974	Oregon	8,287	Schuyler	7,867
Bates	18,960	Dallas	8,383	Laclede	9,380	Ozage	10,793	Scotland	10,676
Benton	11,322	Dawies	14,410	Lafayette	22,623	Osark	8,363	Scott	7,317
Bollinger	8,162	De Kalb	9,858	Lafayette	13,067	Pemiscot	2,059	Shannon	2,339
Boone	20,768	Dent	6,367	Lewis	15,114	Perry	9,577	Shelby	10,119
Buchanan	30,350	Douglas	8,918	Lincoln	14,073	Pettis	18,706	Shoemaker	8,535
Butler	4,298	Dunklin	5,982	Linn	15,900	Phelps	10,506	St. Louis	3,253
Caldwell	11,390	Franklin	30,098	Livingston	16,041	Pike	23,076	Sullivan	11,908
Callaway	19,202	Gasconade	10,093	Macon	33,230	Platte	17,330	Taney	4,407
Camden	6,108	Gentry	11,607	Madison	8,849	Polk	12,445	Texas	9,618
C. Girard	17,558	Green	21,849	Maries	8,918	Pulaski	4,714	Vernon	11,246
Carroll	17,445	Grundy	10,267	Marion	22,504	Putnam	11,217	Warren	9,673
Cass	19,298	Harrison	14,638	McDonald	5,226	Ralls	10,510	Washington	11,719
Carter	1,455	Henry	17,401	Mercer	1,587	Randolph	15,908	Wayne	6,058
Cedar	9,474	Hickory	6,452	Miller	6,616	Ray	18,700	Webster	10,434
Chariton	19,135	Holt	11,652	Mississippi		Reynolds	3,760	Worth	5,004
Christian	6,707	Howard	17,233	Monroe	11,335	Ripley	3,175	Wright	5,684
Clark	13,667	Howell	4,218	Monroe	17,149	St. Charles	21,304	Total	1,771,788

NEBRASKA.—Area, 75,995 square miles

Adams	13	Blk Bird . .	31	Buffalo . . .	193	Burt	2,847	Butler	1,255
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CENSUS OF THE UNITED STATES.

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Calhoun.....	Pt. Randall.....	Kearney.....	53	Pierce.....	103	Wayne.....	9
Cass.....	8,151	Franklin.....	36	Platte.....	1,899	Webster.....	16
Cedar.....	1,032	Gage.....	473	Polk.....	136	York.....	604
Cheyenne.....	190	Grant.....	484	Lincoln.....	17	Richardson.....	9,780
Clay.....	54	Green.....	78	Lyon.....	3,106	Sallie.....	34
Colfax.....	1,434	Hall.....	1,087	Madison.....	1,133	Sarpy.....	2,913
Cuming.....	12,345	Hamilton.....	130	Merrick.....	857	Saunders.....	4,547
Dakota.....	2,040	Harrison.....	631	Monroe.....	235	Seward.....	2,993
Dawson.....	103	Jackson.....	9	Nemaha.....	7,593	Shorter.....	187
Dixon.....	1,345	Jefferson.....	2,446	Nucolla.....	8	Stanton.....	1,637
Dodge.....	4,212	Johnson.....	5,429	Otoe.....	12,345	Taylor.....	197
Douglas.....	19,982	Jones.....	.....	Pawnee.....	2,637	Washington.....	4,453
Fillmore.....	233	.....	.....	.....	.....	State.....	2

NEVADA.—Area, 112,090 square miles.

Carson.....	Emerald.....	1,553	Lyon.....	1,837	Pah Ute... 763	St. Mary's.....
Churchill... 196	Humboldt... 1,916	Nye.....	1,087	Hoop..... 133	Washoe... 3,091	
Douglas... 1,215	Lander.... 2,815	Ormsby... 3,668	Storey..... 11,359	White Pine 7,189		
Elko..... 3,447	Lincoln... 2,223	Total.....				42,491

NEW HAMPSHIRE.—Area, 9,280 square miles.

Belknap.....	17,681	Cheshire.....	27,265	Grafton.....	39,103	Merrimack.....	42,151	Stratford.....	30,242
Carroll.....	17,332	Cook.....	14,932	Hillsboro.....	64,235	Hockingham.....	47,299	Sullivan.....	18,058
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	318,300

NEW JERSEY.—Area, 8,320 square miles.

Atlantic.....	14,093	Cumberland.....	31,665	Hunterdon.....	39,963	Morris.....	43,137	Somerset.....	22,810
Bergen.....	30,142	Essex.....	143,815	Mercer.....	46,386	Ocean.....	13,630	Sussex.....	25,168
Burlington.....	53,638	Gloucester.....	21,562	Middlesex.....	.....	Passaic.....	46,416	Union.....	41,865
Camden.....	46,038	Hudson.....	129,068	Monmouth.....	46,196	Salem.....	23,940	Warren.....	34,348
Cape May.....	8,349	Total.....	.....	.....	.....	.....	.....	.....	905,794

NEW YORK.—Area, 47,000 square miles.

Albany.....	123,053	Dutchess.....	74,404	Livingston.....	35,310	Ontario.....	48,969	Steuben.....	67,717
Allegany.....	40,814	Erie.....	178,695	Madison.....	43,522	Putnam.....	15,420	Suffolk.....	46,960
Broome.....	44,107	Essex.....	29,042	Monroe.....	117,867	Queens.....	73,804	Sullivan.....	34,546
Cattaraugus.....	43,900	Franklin.....	30,271	Montgomery.....	34,457	Rensselaer.....	95,550	Tioga.....	30,573
Chautauque.....	69,549	Fulton.....	27,064	New York.....	922,531	Richmond.....	33,029	Tompkins.....	33,180
Chemung.....	35,281	Genesee.....	31,608	Niagara.....	50,430	Rockland.....	25,213	Ulster.....	84,075
Chenango.....	40,563	Greene.....	31,832	Oneida.....	110,009	Saratoga.....	51,529	Warren.....	22,591
Clinton.....	48,028	Hamilton.....	2,960	Onondaga.....	104,144	Schenectady.....	21,347	Washington.....	49,570
Columbia.....	47,044	Herkimer.....	39,922	Ontario.....	46,106	Schoharie.....	33,340	Wayne.....	47,711
Cortland.....	25,174	Jefferson.....	65,415	Orange.....	80,901	Schoharie.....	33,340	Westchester.....	193,228
Delaware.....	42,972	Kings.....	419,926	Orleans.....	27,589	Schuyler.....	18,889	Wyoming.....	29,162
.....	.....	Lewis.....	26,700	Oswego.....	77,942	Seneca.....	27,826	Yates.....	15,895
Total.....	.....	.....	.....	.....	.....	.....	.....	.....	4,364,411

NORTH CAROLINA.—Area, 60,704 square miles.

Alamance.....	11,874	Chowan.....	6,450	Guilford.....	21,735	Hoke.....	24,299	Rowan.....	16,811
Alexander.....	6,868	Clay.....	2,463	Halifax.....	20,407	Mitchell.....	4,705	Rutherford.....	13,121
Alleghany.....	6,697	Cleveland.....	12,696	Harnett.....	8,595	Montgomery.....	7,487	Sampson.....	16,452
Anson.....	13,428	Columbus.....	8,474	Haywood.....	7,921	Moore.....	12,040	Stanly.....	4,315
Ashe.....	6,573	Craven.....	20,516	Henderson.....	7,708	Nash.....	11,077	Stokes.....	11,908
Beaufort.....	13,054	Cumberland.....	17,035	Hertford.....	9,273	N. Haver.....	27,978	Surry.....	11,252
Bertie.....	13,950	Currituck.....	5,131	Hyde.....	6,445	Northampton.....	14,749	Transylvania.....	8,536
Bladen.....	12,831	Dane.....	2,728	Island.....	16,931	Onslow.....	7,569	Tyrrell.....	4,173
Brunswick.....	7,754	Davidson.....	17,255	Jackson.....	6,683	Orange.....	17,507	Union.....	12,318
Buncombe.....	16,412	Davis.....	9,620	Johnson.....	14,158	Pasquotank.....	8,131	Wake.....	35,617
Burke.....	9,777	Duplin.....	15,542	Jones.....	8,002	Perquimans.....	7,945	Warren.....	17,768
Cabarras.....	11,954	Edgemont.....	22,970	Lenoir.....	10,434	Person.....	11,170	Washington.....	6,616
Caldwell.....	8,476	Forsyth.....	13,050	Lillington.....	.....	Pitt.....	17,276	Watauga.....	6,267
Camden.....	8,361	Franklin.....	14,134	Lincoln.....	9,872	Polk.....	4,319	Wayne.....	18,144
Carteret.....	9,810	Gaston.....	12,602	Nacoe.....	6,315	Randolph.....	17,555	Wilkes.....	15,533
Caswell.....	16,081	Gates.....	7,724	Madison.....	8,192	Richmond.....	12,882	Wilson.....	12,258
Catawba.....	10,984	Granville.....	24,831	Martin.....	9,647	Robeson.....	13,251	Yadkin.....	10,697
Chatham.....	19,723	Greene.....	6,687	McDowell.....	7,592	Hockingham.....	15,710	Yancey.....	8,909
Cherokee.....	8,069	Total.....	.....	.....	.....	.....	.....	.....	1,065,504

OHIO.—Area, 39,964 square miles.

Adams.....	20,750	Clermont.....	24,296	Franklin.....	63,019	Hocking.....	17,925	Madison.....	15,633
Allen.....	23,623	Clinton.....	21,915	Fulton.....	17,789	Holmes.....	18,178	Mahoning.....	31,001
Ashland.....	21,933	Columbiana.....	28,299	Gallia.....	25,545	Huron.....	28,532	Marion.....	16,184
Ashtabula.....	32,518	Coshocton.....	23,600	Ceauga.....	13,069	Jackson.....	21,759	Medina.....	20,092
Athens.....	21,872	Crawford.....	25,556	Greene.....	28,052	Jefferson.....	29,188	Meigs.....	31,465
Auglaize.....	20,040	Cuyahoga.....	132,012	Guernsey.....	22,798	Knox.....	26,333	Mercer.....	17,254
Belmont.....	39,716	Darke.....	32,131	Hamilton.....	280,370	Lake.....	15,935	Miami.....	32,740
Brown.....	30,802	Defiance.....	15,719	Hancock.....	22,847	Lawrence.....	31,380	Monroe.....	25,798
Butler.....	39,913	Delaware.....	25,175	Hardin.....	16,714	Licking.....	36,122	Montgomery.....	63,697
Carroll.....	14,491	Erie.....	26,153	Harrison.....	16,682	Logan.....	23,028	Morgan.....	20,363
Champaign.....	24,189	Fairfield.....	31,129	Henry.....	14,028	Loraine.....	30,308	Morrow.....	18,553
Clark.....	32,070	Payette.....	17,170	Highland.....	22,103	Lucas.....	46,783	Muskingum.....	44,967

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Noble	19,949	Portage	34,577	Scioto	29,302	Tuscaraw'	53,840	Washing'n	40,609
Ottawa	12,225	Preble	31,809	Seneca	30,529	Union	18,730	Wayne	33,082
Paulding	9,844	Putnam	17,083	Shelby	20,745	Van Wert	18,534	Williams	20,991
Perry	19,458	Richland	32,516	Stark	52,808	Vinton	18,027	Wood	34,596
Pickaway	34,975	Ross	37,097	Summit	34,074	Warren	26,090	Wyandotte	18,554
Pike	18,441	Sandusky	25,504	Trumbull	38,669	Total			2,082,314

OREGON.—Area, 102,608 square miles.

Baker	2,804	Columbia	863	Josephine	1,304	Polk	4,700	Union	7,552
Benton	4,584	Curry	504	Lane	6,426	Tillamook	408	Wasco	2,509
Coos	1,644	Douglas	6,068	Linn	8,717	Umpqua		Washing'n	4,261
Clackamas	5,993	Grant	2,281	Marion	9,968	Umatilla	2,914	Yam Hill	5,012
Clatsop	1,254	Jackson	4,778	Multnomah	11,510	Total			90,922

PENNSYLVANIA.—Area, 46,000 square miles.

Adams	20,515	Chester	77,805	Franklin	45,365	McKean	8,825	Snyder	15,007
Allegheny	262,373	Clarion	26,960	Fulton	9,360	Mercer	49,979	Somerset	29,226
Armstrong	43,383	Clearfield	25,740	Greene	25,887	Mifflin	17,508	Sullivan	6,191
Beaver	26,150	Clinch	23,211	Huntington	40,995	Monroe	18,362	Susquehanna	37,534
Bedford	29,635	Columbia	26,766	Indiana	36,132	Montgomery	81,772	Tioga	25,100
Berk	106,739	Crawford	63,794	Jefferson	21,656	Montour	15,324	Union	16,565
Blair	39,051	Cumberland	43,912	Juniata	17,890	Northampton	61,433	Venango	47,935
Bradford	53,904	Dauphin	60,730	Lancaster	121,540	Northwestern	41,440	Warren	23,897
Bucks	64,245	Delaware	39,403	Lawrence	27,398	Perry	25,496	Washing'n	48,483
Butler	36,510	Elk	8,488	Lebanon	34,098	Philadelphia	674,022	Wayne	53,178
Cambria	36,569	Erie	66,972	Lehigh	56,796	Pike	8,436	Westmoreland	58,720
Cameron	4,273	Fayette	43,284	Luzerne	100,737	Potter	11,265	Wyoming	14,588
Carbon	28,144	Forest	4,010	Lycoming	47,029	Schuylkill	105,869	York	76,216
Centre	34,404	Total							3,429,248

RHODE ISLAND.—Area, 1,305 square miles.

Bristol	9,421	Kent	18,598	Newport	20,050	Providence	149,193	Washing'n	20,097
Total									217,356

SOUTH CAROLINA.—Area, 29,385 square miles.

Abbeville	31,129	Clarendon	30,018	Greenville	20,018	Marion	13,727	Richland	13,727
Anderson	24,049	Colleton	24,014	Horry	10,721	Marlboro'	11,814	Spartanburg	25,784
Barnwell	35,844	Columbia	9,298	Kershaw	11,754	Newberry	17,983	Sumter	25,268
Beaufort	40,511	Darlington	22,391	Lancaster	12,087	Oconee	10,536	Union	19,248
Charleston		Edgefield	42,486	Laurens	22,536	Orangeburg		Williamsburg	15,480
Chester	18,805	Fairfield		Lexington		Pickens	10,260	York	12,448
Chesterd'		Georgetown	16,161						

TENNESSEE.—Area, 45,800 square miles.

Anderson	8,704	De Kalb	11,425	Henderson	14,219	Greene	6,866	Sequatchie	2,335
Bedford	24,334	Dickson	9,940	Henry	20,582	Marshall	16,207	Serier	11,028
Benton	8,234	Dyer	13,706	Hickman	9,558	Mauy	26,286	Shelby	76,378
Bledsoe	4,870	Fayette	26,865	Humphrey	9,326	Meigs	4,511	Smith	15,994
Blount	14,237	Fentress	4,717	Jackson	12,585	Monroe	12,585	Stewart	12,010
Bradley	11,552	Franklin	14,970	Jefferson	19,478	Montgomery	24,708	Sullivan	13,136
Campbell	7,445	Gibson	25,670	Johnson	8,852	Morgan	2,969	Sumner	23,711
Cannon	10,509	Giles	22,413	Knox	28,994	Obion	15,608	Tipton	14,884
Carroll	19,447	Granger	12,461	Lake	2,428	Overton	10,980	Union	7,605
Carter	7,909	Greene	21,668	Lauderdale	10,838	Perry	9,926	Van Buren	2,725
Cheatham	6,678	Grundy	2,251	Lawrence	7,409	Polk	7,869	Warren	12,715
Claiborne	9,321	Hamilton	17,341	Lewis	1,983	Putnam	6,698	Washing'n	16,318
Coke	12,458	Hancock	7,148	Lincoln	25,051	Rhea	4,534	Wayne	10,269
Coffee	10,227	Hardeman	17,769	McMinn	13,968	Roane	15,623	Weakly	20,765
Cumberland	8,461	Hardin	11,770	McNairy	17,726	Robertson	16,166	White	9,328
Davidson	62,896	Hawkins	18,848	Macon	6,633	Rutherford	23,289	Williamson	28,352
Decatur	7,775	Haywood	23,095	Madison	23,650	Scott	4,054	Wilson	26,884
Total									1,267,923

TEXAS.—Area, 237,504 square miles.

Anderson		Brown		Concho		Fannin		Haskell	
Angelino		Buchanan		Cook		Fayette		Hays	4,088
Archer		Burleson		Coryell		Fort Bend	7,114	Henderson	
Atacosa		Burnett		Dallas		Freestone		Hidalgo	2,387
Austin	15,087	Caldwell		Davis		Frio		Hill	7,453
Bakers	642	Calhoun		Dawson		Galveston	15,290	Hood	
Bastrop		Cameron	10,099	Denton		Gillespie		Hopkins	
Baylor		Cass		De Witt	6,443	Goliad	5,628	Houston	
Bee		Chambers	1,503	Dimmitt	866	Gonzales		Hunt	
Bell	1,082	Cherokee		Duval		Grayson		Jack	694
Bexar		Clay		Eastland		Grimes		Jackson	2,776
Bexar Dis		Coleman		Edwards		Guadalupe		Jasper	4,218
Blanco		Callahan		Ellis	7,614	Hamilton		Jefferson	1,908
Bowie		Collin		El Paso		Hardeman		Johnson	
Brewster		Colorado	8,326	Ensinal		Hardin	1,400	Jones	
Brazoria	7,526	Comal	5,283	Erath		Harris	17,374	Karnes	
Brazos		Comanche		Falls		Harrison		Kaufman	

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Kendall	1,536	Mason	Orange	1,255	Shackelford	Victoria
Kerr	1,043	Metagorda	Palo Pinto	Shelby	Walker	0,776
Kimball	73	Mayerick	Panola	Smith	Washing'n	
Kinney		McCulloch	Parker	Starr	Webb	
Knox		McLennan	Polk	Stevens	Wharton	8,428
Lamar		McMullen	Presidio	Tarrant	Wichita	
Lampasas	1,344	Medina	Red River	Taylor	Wilbarger	
Lasalle	69	Menard	Refugio	Tarockm'a	Williamson	
Lavaca	0,168	Milan	Robertson	Titus	Wilson	
Leon		Montague	Russell	Travis	Wise	1,453
Liberty	4,413	Montgomery	Rusk	Trinity	Wood	
Limestone		Nacogdoch	Sabino	Tyler	Young	
Live Oak	653	Navarro	S. Auguste	Uphur	Y'g Ter'y	
Llano	1,373	Newton	S. Patricio	Uvalde	Zapata	1,453
Madison		Nueces	San Saba	Van Zandt	Zavalla	
Marion						

VERMONT.—Area, 10,212 square miles.

Addison	21,484	Chittenden	Grand Isle	Orleans	31,035	Windham
Bennington	21,325	Essex	Lamoille	Rutland		Windsor
Caledonia		Franklin	Orange	Washington		

VIRGINIA.—Area, 88,362 square miles.

Accomack	20,469	Craig	2,042	Highland	4,161	Nelson	13,828	Roanoke	9,850
Albemarle	27,544	Culpeper	12,227	Isle of Wight	18,330	New Kent	4,381	Rockbridge	16,023
Alexandria	16,765	Cumbar'd	8,142	Jackson		Nicholas		Russell	11,103
Alleghany	2,674	Dinwiddie	30,702	James City	4,425	Norfolk	46,702	Scott	9,927
Amelia	9,878	Doddridge		Jefferson		Northam'n	8,046	Shenandoah	14,935
Amherst	14,900	Elizabeth Cy	8,303	Kanawha		Northum'd	8,863	Smyth	8,928
Appomattox	8,880	Essex	9,927	K'g George		Nottoway	9,291	Southern	12,285
Augusta	28,763	Fairfax	12,523	K'g & Q'n	9,709	Ohio		Spotsylvania	11,728
Bath		Fauquier	19,696	K'g Will'm	7,896	Orange	10,896	Stafford	6,420
Bedford	26,327	Fayette		Lancaster	8,355	Page	8,463	Sussex	7,883
Berkeley		Floyd	2,824	Lee	13,368	Patrick	10,161	Surry	5,585
Boone		Fluvanna	8,973	Lewis		Pendleton		Taylor	
Boone		Franklin	18,264	Logan		Pittsylvania	21,543	Tazewell	10,791
Bland	4,000	Frederick	16,596	Loudon	20,929	Pleasants		Tucker	
Botetourt	11,320	Giles	5,669	Louis	16,332	Pocahontas		Tyler	
Braxton		Gloucester	10,211	Lynchburg	10,405	Powhatan	7,667	Uphur	
Brooke		Goochland	10,313	Madison		Preston		Warwick	1,672
Brunswick	13,427	Grayson	9,687	Marshall		Pr. Edw'd	12,004	Warren	8,716
Buchanan	8,777	Greenbrier	6,363	Mathews	6,200	Pr. George		Washington	16,816
Buckingham	13,371	Greene	4,634	McDowell	1,300	Pr. Will'm	7,804	Wayne	
Cabell		Hallfax		Mecklenburg	31,318	Pr. Anne	8,273	Webster	
Calhoun		Hancock		Mercer		Pulaski	6,533	Westmor'd	7,682
Campbell	28,384	Hardy		Middlesex	4,931	Raleigh		Wetzel	
Caroline	15,128	Harrison	16,455	Monongalia	13,547	Randolph		Wood	
Carroll	9,147	Henrico	68,179	Monroe	11,124	Ritchie	9,055	Wirt	
Clay		Henry	12,303	Morgan		Roane	7,232	Wyoming	5,171
Charles C'y	4,975			Nansemond	11,676	Total		York	7,198
Charlotte	14,513							Total	1,224,630
Chesterfield	18,470								
Clarks	6,670								

WEST-VIRGINIA.—Area, 23,000 square miles.

Barbour	12,958	Grant	4,468	Logan	5,124	Ohio	28,831	Taylor	9,367
Berkeley	14,900	Greenbrier	15,211	McDowell	1,983	Pendleton	6,455	Tucker	1,907
Boone	4,503	Hampshire	7,543	Marion	12,107	Pleasants	3,012	Tyler	7,532
Braxton	6,841	Hancock	4,383	Marshall	14,941	Pocahontas	4,070	Uphur	8,023
Brooke	5,464	Hardy	5,518	Mason	15,978	Preston	14,554	Wayne	7,882
Cabell	6,439	Harrison	17,599	Mercer	7,064	Putnam	7,794	Webster	1,780
Calhoun	2,939	Jackson	10,300	Mineral	6,349	Raleigh	3,672	Wetzel	8,895
Clay	2,196	Jefferson	13,320	Monongalia	13,547	Randolph	5,663	Wirt	4,505
Doddridge	7,076	Kanawha	22,380	Monroe	11,124	Ritchie	9,055	Wood	19,060
Fayette	6,647	Lewis	10,176	Morgan	4,315	Roane	7,232	Wyoming	5,171
Gilmore	4,338	Lincoln	8,083	Nicholas	4,486	Total			445,616

WISCONSIN.—Area, 53,924 square miles.

Adams	6,601	Columbia	28,813	Green	23,611	Manitowoc	83,304	Portage	10,636
Ashland	221	Crawford	13,076	Green Lake	13,195	Marathon	8,583	Racine	23,740
Bad Ax		Dallas		Iowa	24,544	Marquette	8,086	Richland	15,732
Barron	538	Dane	83,026	Jackson	7,696	Milwaukee	89,941	Rock	29,634
Bayfield	344	Dodge	47,039	Jefferson	34,042	Monroe	16,551	St. Croix	11,065
Brown	28,166	Dor	4,922	Jones	13,372	Oconto	8,321	Sauk	23,860
Buffalo	11,122	Douglas	1,122	Kenosha	13,167	Outagamie	18,430	Shawano	3,166
Burnett	708	Dunn	9,489	Kewaunee	10,120	Ozaukee	15,568	Sheboygan	31,749
Calumet	12,334	Eau Claire	10,770	La Crosse	20,298	Perkin	4,661	Trempealeau	10,723
Chippewa	8,345	Fond d' Lac	45,272	La Fayette	22,669	Pierce	9,359	Vernon	18,445
Clark	2,450	Grant	37,978	La Pointe		Polk	8,432	Walworth	26,671

Washing'n. 24,320	Waupacca 15,640	Wauwaha 11,279	Winnabago 37,230	Wood 2,919
Waukesha 22,282	Total			1,035,167
DISTRICT OF COLUMBIA—Area, 60 square miles.				
Georgetown 11,385	Washing'n. 109,204	Bal. Dist. 11,117	Total	131,706

TERRITORIES.

ARIZONA—Area, 113,918 square miles.									
Mohave	173	Pima	5,716	Yavapai	2,142	Yuma	1,621	Total	9,650
COLORADO—Area, 104,500 square miles.									
Arapahoe	3,829	Costilla	1,779	Gilpin	5,490	Lake	523	Puebla	2,265
Bent	532	Douglas	1,383	Greenwood	510	Larimer	839	Saguache	804
Boulder	1,939	El Paso	987	Huerfano	2,250	Las Animas	4,276	Summit	286
Clear Creek	1,596	Fremont	1,064	Jefferson	2,300	Park	447	Weld	1,478
Conejos	2,504	Total							39,706
DAKOTA—Area, 150,932 square miles.									
Bon Homme	606	Clay	2,621	Lincoln	712	Todd	237	Unorganized	
Brookings	168	Deuel	37	Minnehaha	855	Union	2,607	portion of	
Buffalo	246	Hutchinson	37	Pembina	1,213	Yankton	2,007	Territory	2,091
Chas. Mix	182	Jayne	5	Total					14,181
IDAHO—Area, 89,294 square miles.									
Ada	2,675	Boise	5,333	Lemhi	983	Owenside	1,922	Shoshone	722
Alturas	683	Idaho	849	Nev. Perces	1,607	Owyhee	1,713	Total	14,966
MONTANA—Area, 143,776 square miles.									
Beaver H'd	722	Dawson	177	Gallatin	1,579	Lewis & Clark	5,041	Meagher	1,387
Bip Horn	88	Deer Lodge	4,364	Jefferson	1,531	Madison	2,634	Missoula	2,554
Chouteau	517	Total							20,594
NEW-MEXICO—Area, 121,201 square miles.									
Arizona		Dona Ana	5,864	Mora	8,056	Santa Fe	9,699	Taos	12,079
Bernalillo	7,569	Grant	1,143	Rio Arriba	9,294	San Miguel	16,086	Valencia	9,093
Cofax	1,993	Lincoln	1,740	Santa Ana	2,599	Socorro	6,603	Total	91,789
UTAH—Area, 84,476 square miles.									
Beaver	2,007	Utah Lake	18,208	Millard	2,753	Sampto	6,786	Utah	12,208
Box Elder	4,812	Green River	1,972	Morgan	1,972	Shamip	1,344	Wasatch	1,344
Cache	6,272	Iron	2,359	Piute	19	Sanir	19	Washing'n	3,064
Cedar		Junab	2,035	Rich	1,855	Summit	2,612	Weber	7,856
Davis	4,459	Kane	1,513	Rio Virgin	450	Tooele	2,177	Total	86,786
WASHINGTON—Area, 69,984 square miles.									
Chehalis	401	Jefferson	1,268	Mason	289	Suwanish	529	Walla Walla	5,300
Clallam	408	King	2,120	Parish	732	Stevens	734	Whitcom	534
Clarke	3,061	Klickitat	866	Pierce	1,469	Thurston	2,246	Yakima	453
Cowlitz	730	Knap	329	Spokane	133	Wahkiak'm	270	The Dal. H's	534
Island	326	Lewis	888	Skamania	133	Total			23,901
WYOMING—Area, 97,983 square miles.									
Albany	2,021	Carbon	1,368	Laramie	2,967	Sweetwater	1,916	Utah	856
		Total							9,118

Cities Having over Ten Thousand Inhabitants.

Census of 1870.

N. York, N. Y. 236,341	Detroit, Mich. 79,580	Reading, Pa. 32,923	Salem, Mass. 24,117
Philad'a, Pa. 1st 657,277	Milwaukee, Wis. 71,499	Columbus, O. 33,745	Quincy, Ill. 24,053
Philad'a, Pa. 2d 674,023	Albany, N. Y. 60,423	Paterson, N. J. 32,502	Manchester, N. H. 23,586
Brook'n, N. Y. 390,300	Providence, R. I. 63,906	Dayton, O. 32,579	Harrisburg, Pa. 23,109
St. Louis, Mo. 310,864	Rochester, N. Y. 62,315	Kansas C'y, Mo. 32,369	Trenton, N. J. 22,674
Chicago, Ill. 359,983	Allegheny, Pa. 53,181	Mobila, Ala. 30,194	Evansville, Ind. 22,830
Baltimore, Md. 367,354	Richmond, Va. 51,038	Portland, Me. 31,414	N. Bedford, Mass. 21,320
Boston, Mass. 350,526	N. Haven, Ct. 50,940	Wilmington, Del. 20,841	Quebec, N. Y. 20,910
Cincinnati, O. 316,239	Charleston, S. C. 48,966	Lawrence, Mass. 28,921	Elizabeth, N. J. 20,688
N. Orleans, La. 191,529	Troy, N. Y. 45,481	Utica, N. Y. 28,804	Lancaster, Pa. 20,232
S. Fran'co, Cal. 149,483	Syracuse, N. Y. 45,058	Toledo, O. 28,546	Savannah, Ga. 20,232
Rudick, N. Y. 117,713	Worcester, Mass. 41,105	Charlot'ton, Mass. 28,328	Pghaespie, N. Y. 20,080
Wash'n, D. C. 109,204	Lowell, Mass. 40,928	Lynn, Mass. 28,233	Camden, N. J. 20,045
Newark, N. J. 105,078	Memphis, Tenn. 40,226	Fall River, Mass. 28,786	Davenport, Ia. 20,042
Louisville, Ky. 100,764	Cambrid'g, Mass. 39,634	Springfield, Mass. 28,703	St. Paul, Minn. 20,091
Cleveland, O. 92,845	Hartford, Ct. 37,189	Nashville, Tenn. 28,573	Erie, Pa. 19,646
Pittsburg, Pa. 86,226	Indianapolis, Ind. 35,565	Peoria, Ill. 25,787	Wheeling, W. V. 19,232
Jersey C'y, N. J. 81,744	Scranton, Pa. 35,092	Covington, Ky. 24,508	Norfolk, Va. 19,206

CENSUS OF THE UNITED STATES.

II

Taunton, Mass. 18,629	Auburn, N. Y. 17,228	Elmira, N. Y. 15,963	Hudson, N. Y. 14,128
Chelsea, Mass. 15,547	Newburg, N. Y. 17,014	Lockport, N. Y. 15,458	Newbury't, Mass. 12,555
Dubuque, Ia. 18,404	Atlanta, Ga. 16,988	Gloucester, Mass. 15,287	Singham't, N. Y. 12,552
Leavenworth, Kan. 17,849	Norwich, Ct. 16,653	Cohoes, N. Y. 15,357	Concord, N. H. 12,241
Pt. Wayne, Ind. 17,718	Sacramento, Cal. 16,454	N. Bruns'w't, Me. 15,059	Schenec'y, N. Y. 11,056
Springfield, Ill. 17,365	Omaha, Neb. 16,063	N. Albany, Ind. 14,378	Ogdensb'g, N. Y. 10,076

Census of the United States—1870. By States.

Alabama 996,961	Maryland 730,394	Pennsylvania 2,515,993	Colorado 20,708
Arkansas 483,179	Massachusetts 1,467,351	Rhode Island 217,358	Dakota 14,181
California 560,385	Michigan 1,164,296	S. Carolina 728,000	Idaho 14,998
Connecticut 537,418	Minnesota 435,511	Tennessee 1,257,983	Montana 20,594
Delaware 185,018	Mississippi 334,170	Texas 797,509	New-Mexico 61,882
Florida 187,754	Missouri 1,715,000	Vermont 230,552	Utah 66,788
Georgia 1,200,000	Nebraska 123,000	Virginia 1,224,810	Washington 23,901
Illinois 2,539,938	Nevada 42,491	West-Virginia 445,616	Wyoming 9,116
Indiana 1,673,046	N. Hampshire 218,300	Wisconsin 1,055,167	Total Territ- ries 442,500
Iowa 1,191,802	New-Jersey 905,794	Total States 38,092,741	Total United States 38,535,241
Kansas 262,873	New-York 4,384,411	TERRITORIES.	Total 38,977,741
Kentucky 1,321,001	N. Carolina 1,060,614	Dis. Columbia 131,708	
Louisiana 732,731	Ohio 2,689,214	Arizona 9,658	
Maine 626,463	Oregon 80,923		

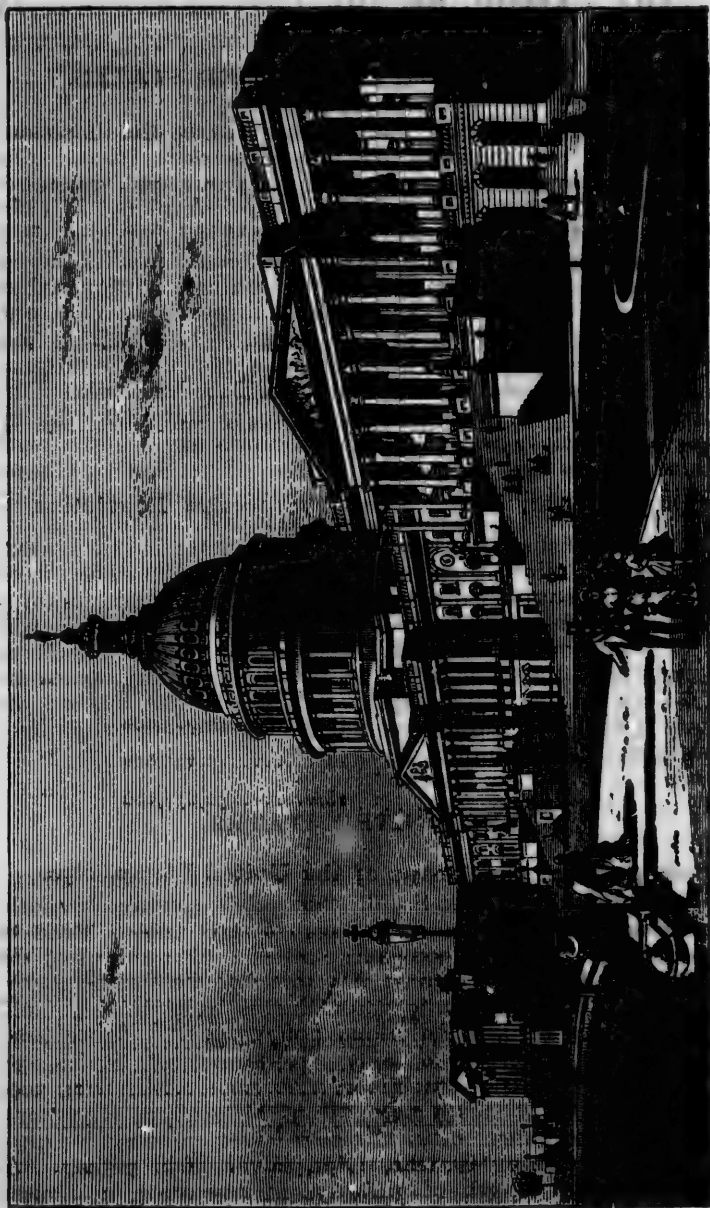
Aggregate Past, Present, and Prospective Population of the United States.

YEAR.	YEAR.
1780.....3,070,000	1875.....44,060,000 (estimated)
1790.....3,929,214	1876.....45,316,000 "
1800.....5,308,483	1877.....46,624,000 "
1810.....7,239,881	1878.....47,983,000 "
1820.....9,658,453	1879.....49,395,000 "
1830.....12,866,020	1880.....50,858,000 "
1840.....17,069,453	
1850.....23,191,876	
1860.....31,443,321	
1870.....38,977,741	

Notes from the Census of the United States, 1870.

Native-born population.....	32,991,142
Foreign-born*	5,567,229
Total white	33,589,377
Colored	4,880,009
Total number of families (average 5.09 persons each).....	7,579,363
dwelling (5.47 persons to each).....	7,942,333
deaths annually (1.28 per cent).....	492,263
births annually	1,100,475

* Irish, 1,835,287. German, 1,690,410. British, 965,027. All others, 1,355,865.



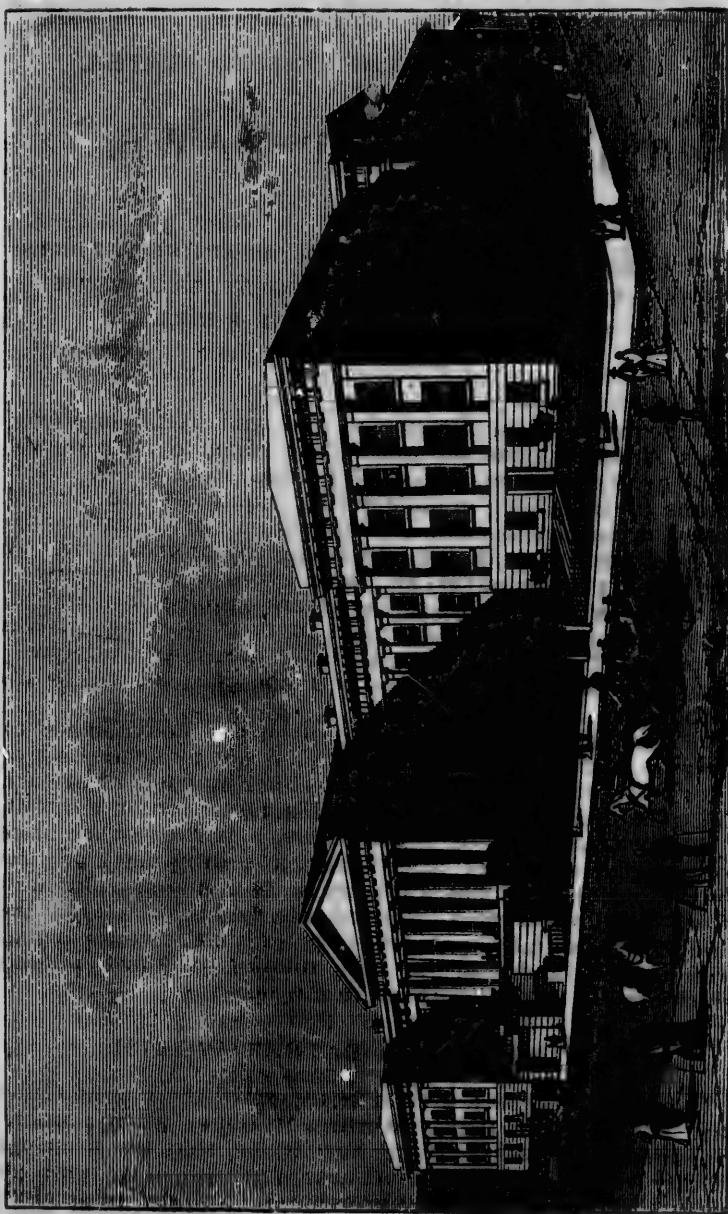
THE CAPITOL OF THE UNITED STATES, AT WASHINGTON.

THE CAPITOL OF THE UNITED STATES.

THE corner-stone of the Capitol was laid by the illustrious Washington, on the 18th day of September, 1793. The building was opened for the meeting of Congress November 17th, 1800. Enlargement and new dome completed in 1867. The edifice fronts the east, is 751 feet long, 348 feet wide, and covers $3\frac{1}{4}$ acres; courtyards, $3\frac{1}{4}$ acres; in all 7 acres. The predominant material of the exterior is white marble. The dome is of cast-iron, $135\frac{1}{2}$ feet in largest diameter, and 287 $\frac{1}{2}$ feet high, surmounted by a statue of Liberty 19 $\frac{1}{2}$ feet high. The interior of the dome forms a remarkable circular chamber, or rotunda, 96 feet in diameter, 180 feet high. One thousand gas jets, flashed by electricity, illuminate the interior by night. The walls of the rotunda are adorned with historical paintings by eminent artists. The Senate Chamber, House of Representatives, Supreme Court Rooms, and other apartments are splendidly decorated. The halls are lined with polished marbles from every State in the Union. Frescoes, paintings, and sculptures abound. The front porticoes are supported by one hundred Corinthian columns of white marble. The cost of the Capitol building was thirteen millions of dollars. It may be justly styled the PALACE OF LAWS, for within its precincts the statutes of the nation are enacted and expounded. Here are framed the patent laws and kindred ordinances for the encouragement of authors and inventors.

THE UNITED STATES.

THE greatest length from East to West is 2800 miles; greatest breadth North to South, 1600 miles; average breadth, 1200 miles. Total area, 3,026,494 square miles; area of Alaska additional, 577,390 square miles. The shores of the Atlantic are for the most part low, those of the Pacific rocky. The length of the Atlantic coast line is 2349 miles; Gulf, 1556; Pacific, 1810, indentations not included. Shore lines of the great lakes, 3450 miles. Number of States, 38. Length of the Mississippi River, 2900 miles; Missouri, 3000 miles. Length of steam navigation, Mississippi River and branches, 7100 miles; ditto Missouri River, 3000 miles; ditto Ohio River, 3292 miles; ditto Red River, 3630 miles. Approximate total length of railways in operation in United States, 1877, 80,000 miles. Approximate total length of telegraph lines, 90,000 miles.



THE UNITED STATES PATENT OFFICE, AT WASHINGTON.—(See page 16.)

THE PATENT LAWS.

WITH DIRECTIONS AND COSTS FOR OBTAINING PATENTS,
CAVEATS, TRADE-MARKS, COPYRIGHTS, ETC., WITH
ABSTRACTS FROM OFFICIAL RULES.

IN the practical application of new and useful improvements, America leads the world; according to an estimate made by the Commissioner of Patents, from six to seven eighths of the entire manufacturing capital of the United States, or upward of six thousand millions of dollars, probably, is based upon patents, either directly or indirectly. A very large proportion of all patents prove remunerative; which is the reason why so many are applied for, and so many millions of capital invested in their working. "But all patents," says an able writer, "are not productive; neither are all farms; all men are not rich; all mines are not bonanzas.

"There is scarcely an article of human convenience or necessity in the market to-day, that has not at some time or other been the subject of a patent, either in whole or in part. The sale of every such article yields the inventor a profit. If we purchase a box of paper collars, a portion of the price goes to the inventor; if we buy a sewing-machine, the chances are that we pay a royalty to as many as a dozen or fifteen inventors at once. Indeed, the field is so vast and the number of profitable patents so great that it would be far preferable to undertake a recapitulation of those patents which are not profitable than those which are."

HOW MUCH IS A PATENT WORTH?

IN an official report, a chief examiner of the Patent Office says: "A patent, if it is worth any thing, when properly managed, is worth and can easily be sold for from ten to fifty thousand dollars. These remarks only apply to patents of ordinary or minor value. They do not include such as the telegraph, the planing machine, and the rubber

16 THE PATENT OFFICE AT WASHINGTON.

patents, which are worth millions each. A few cases of the first kind will better illustrate my meaning:

"A man obtained a patent for a slight improvement in straw-cutters, took a model of his invention through the Western States, and after a tour of eight months returned with forty thousand dollars in cash, or its equivalent.

"Another inventor obtained extension of a patent for a machine to thresh and clean grain, and sold it in about fifteen months for sixty thousand dollars. A third obtained a patent for a printing-ink, and refused fifty thousand dollars, and finally sold it for about sixty thousand dollars.

"These are ordinary cases of minor invention, embracing no very considerable inventive powers, and of which hundreds go out from the Patent Office every year. Experience shows that the most profitable patents are those which contain very little real invention, and are to a superficial observer of little value."

THE PATENT OFFICE AT WASHINGTON.

THE engraving on page 14 shows a full exterior view of the Patent Office, which is one of the finest edifices in Washington. It is of the Doric order of architecture, 433 feet long, 331 feet wide, 75 feet high. The collection of models of inventions here gathered is very remarkable, the aggregate number being over two hundred thousand. Nearly twenty thousand new models are sent to the Patent Office each year.

PROCEEDINGS TO OBTAIN A PATENT.

To one who has made an invention or discovery, the first inquiry that suggests itself is, "Can I obtain a Patent?" If so, "How shall I proceed? Whom shall I consult? How much will it cost?" The quickest way to settle these queries without expense is to write to us (Munn & Co.) describing the invention. Send us also a small sketch. Never mind your inexperience. Nicety of writing or drawing is not essential; all we need is to get *your idea*. Do not use pale ink. Be brief. Send stamps for postage. We will immediately answer and inform you whether or not your improvement is probably patentable; and if so, give you the necessary instructions for further procedure. Our long experience enables us to decide quickly. For this advice we make *no charge*. All who desire to consult us in regard to obtaining patents, are cordially invited to do so. We shall be happy to see them in person at our office, or to advise them by letter. In all cases they may expect from us a careful consideration of their plans, an honest opinion, and a prompt reply.

Inquiries about the *patentability of new inventions* we answer, as above stated, *without charge*. But we frequently receive letters containing strings of other questions, without fee, or even postage-stamps. Some of these letters close with the comforting assurance; "I would remit for your trouble, but do not know how much to send." To relieve the consciences of all such doubters, we would recommend them to send a dollar or more, according to the value to them of the desired information. If the latter is of no value, they ought not to trouble us. To other inquirers the following hints may be useful: The best washing-machines, the best brick-machines, *the best of every thing in the mechanical line*, is advertised and illustrated in the SCIENTIFIC AMERICAN, and the address of the parties having such things on sale is there given. If not a subscriber to the SCIENTIFIC AMERICAN, you should enroll your name by sending \$3.20 for one year, which includes the postage. You will sooner or later find in its pages answers to all your inquiries, together with an immense amount of other useful information.

THE PRELIMINARY EXAMINATION.

If we are not entirely satisfied that our correspondent's idea is patentable, we advise him to let us make a Preliminary Examination. This consists of a *special search*, made at the U. S. Patent Office, Washington, through the medium of our house in that city, to ascertain whether, among all the thousands of patents and models there stored, any invention can be found which will probably prevent the grant of a patent. On the completion of this special search, we send a *written report* to the party concerned, with suitable advice. Our charge for this service is five dollars.

If the report is unfavorable, the applicant is saved all further expense. If favorable, he is enabled to modify or enlarge his claims in accordance with the report.

In offering to make this examination for five dollars, our correspondents must bear in mind that we here refer only to the question of the *patentability* of the invention, not to infringements or other questions. Will it pay? Does it infringe? See page 26 for reply.

Where preliminary examination is wanted upon more than one invention, \$5 for each must be sent; as each device requires a separate search. All that we need for this examination is a brief description and sketch sufficient to enable us to get an idea of the invention.

The fee paid for preliminary examination does not go toward paying for the patent.





What security have I that my communications to Munn & Co. will be faithfully guarded and remain confidential?

Answer.—You have none except our well-known integrity in this respect, based upon a most extensive practice of thirty years' standing. Our clients are numbered by hundreds of thousands. They are to be found in every town and city of the Union. Please to make inquiry about us. Such a thing as the betrayal of a client's interests, when committed to our professional care, never has occurred, and is not likely to occur. All business and communications intrusted to us are kept *secret and confidential*.

COST OF THE PATENT.

If the invention is simple, the whole cost to apply for a patent is \$40,* and when allowed, \$20 more are payable, making \$60 in all.† The applicant has six months in which to pay the last instalment of \$20, after the patent is allowed. If the invention is complicated, the costs are somewhat increased, because the preparation of the drawings and specifications involves extra labor.

Under the patent laws, all persons, citizens and foreigners, pay the same official fees. There is no distinction as to nationality. Patents are also granted to women and minors; also to the executors or administrators of deceased inventors. The patent is granted for seventeen years, during which time the patentee enjoys the full and exclusive right to make, use, and sell the invention, and grant rights, licenses, or privileges.

In order to apply for a patent, all that is necessary is to send a model of the invention to Munn & Co., by express, prepaid, with an explanation of the merits and working of the invention. Never mind spelling or grammar, but be very particular to give your ideas in full about the invention. Describe its intended working, and mention all the advantages that you can think of. This statement is always of assistance to us in preparing the specification and drawings. Also remit \$15 on account, and give the inventor's full name, middle name included. We will then prepare the drawings and specification, and send the latter to you for examination and signature. See page 22 about model.

Do not put the money in the box with the model, for it is

* If a patent is not granted, the applicant loses this cost of making the application.

† Of this sum the first Government fee is \$15, our (Munn & Co.'s) charges \$25, and the second Government fee is \$20, making \$60 in all. When an appeal is required, there are additional expenses. See page 26.

liable to be stolen. Remit by express, postal order, check, or draft, to order of Munn & Co., 37 Park Row, New York.

When the invention consists of a process or new article of manufacture, or a new composition, samples of the article must be furnished, and a minute detail of the mode of production given. New medicines or compounds, and useful mixtures, recipes, etc., may be patented. Samples must be furnished, and a minute statement given of the exact proportions, method, and ingredients used in making a given quantity of the new article. In the case of medicines it is sometimes better for the author to keep the recipe a secret, and register a trade-mark under which to sell and introduce the article. See trade-marks, page 30.

On the reception of the model or specimen and first payment of \$15, the case is duly registered upon our books, and the application proceeded with as fast as possible. When the documents are ready, we send them to the inventor by mail, for his examination, signature, and affidavit, with a letter of instruction, etc. Our charges for preparing the case are then due and will be called for. On return of the papers to us, the case will be presented to the Patent Office, and as soon as the patent is *allowed*, the applicant will be notified to remit the last instalment of the Government fee—namely, \$20, and the patent will then be printed and issued.

In addition to the above service, our patron receives, gratis, a notice in the *SCIENTIFIC AMERICAN*, descriptive of the merits of the new patent, giving also his name and address. *We print and distribute about fifty thousand copies of this notice*, without a penny of cost to our client. This publication is of immense value to the patentee in advertising his new invention, and assisting to bring it promptly to the attention of purchasers. Were he to do this printing himself, it would cost him, by the most economical method, say on the backs of postal-cards, over five hundred dollars. The printing alone would cost him fifty dollars, and the cards ten dollars per thousand; to which must be added the cost of addressing.

No patent agency in the world does so much for its clients as ours; and for that reason none so fully commands public confidence or enjoys so great a share of patronage.

Persons who do business with us will be notified of the progress of their application in the Patent Office, when it is possible for us to do so. We do not require the personal attendance of the inventor, unless the invention is one of great complication; the business can be done as well by correspondence.

We have an extensive branch house in Washington (see

engraving, page 24), employing a corps of skilled assistants, and we make it our special duty to watch over the cases of our clients while they are before the Patent Office. If the examining officer objects to the grant of a claim, needs personal explanations, or requires amendments, we examine the references and make the amendments, if we deem them proper, so as to secure the allowance of our client's patent as soon as possible. We make no additional charge for these services.

The average time required to procure a patent is six weeks. We frequently get them through in less time, but in other cases, owing to delay on the part of the officials, the period is sometimes extended to two or three months, and even more. We make a special point to forward our cases *as rapidly as possible*.

ABOUT MODELS.

WHOEVER applies for a patent is by law required to furnish a model, if the invention can be illustrated, or partly illustrated, by a model. It is therefore useless to write letters asking to be excused from sending a model. The model must not exceed twelve inches in any of its dimensions; should be neatly made.

If the invention is an improvement upon some existing machine, it is not generally necessary to make a model of the whole machine. All that is required is to illustrate by model the intended construction and intended working of the improved parts. The model of a car-coupler, for example, need not embrace a complete car, wheels, etc., but only the coupler parts. In a steam-engine, if, for example, the invention relates to an improvement in the cylinder, the model of a cylinder only is sufficient, and it may be made of wood. Models may be made of such materials as the applicant finds most convenient—wood or metal, or part wood, part metal. It is not necessary to make the model of the same materials that are to compose the manufactured article. For example, the Patent Office will receive a model in wood, representing an improved inkstand that is intended to be manufactured in glass.

Sometimes a correspondent writes: "I am a poor hand at making models. If I employ a model-maker, do I not run a risk that he will steal the invention and take the patent in his own name?" Our answer is, that you run little risk of having your ideas stolen, especially if you take the precaution to deal with a person of good repute. For your own satisfaction, however, you may explain your invention to the model-

maker in presence of a friend; and the evidence of the latter would be sufficient to defeat any attempt made to take your invention.

It is always better for inventors to have their models constructed under their own supervision, even at an increased cost in money or time. During the making of the model, the author often perceives points where the invention may be rendered more perfect than was at first contemplated. The model should be small, but strong. In some instances, owing to residence in distant parts or other causes, it is impossible for the inventor to furnish a model. In such cases we (MUNN & Co.) can have proper models built by experienced and trusty makers, at moderate charges.

Models may be sent to us either by mail or by express, *prepaid*. If sent by mail, the postage is *one cent an ounce*, provided there is no writing on the model or within the package. The ends of the package should be open, so that it can be examined. But if the sender writes his name upon the model, it then becomes subject to letter postage, which is six cents an ounce.

Prepay all models, and address them MUNN & Co., 37 Park Row, New York.

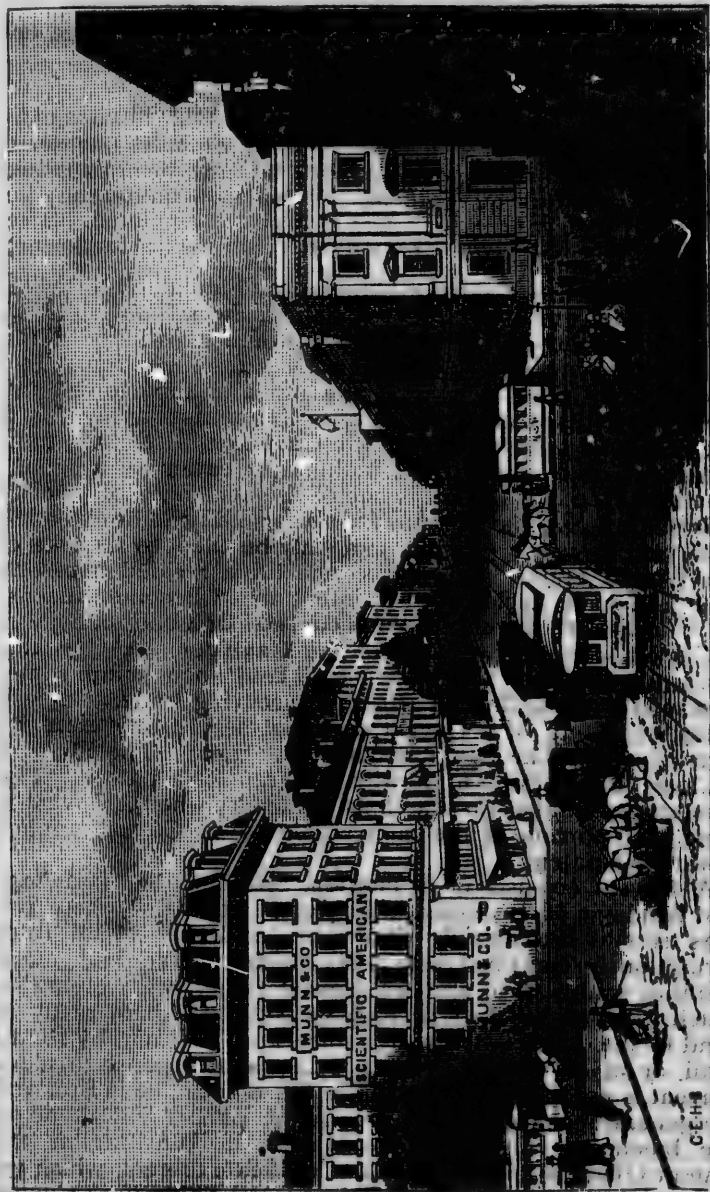
GOING TO WASHINGTON.

SOME inventors suppose, very naturally, that if personally present in Washington, they can get their cases through more expeditiously, or command other important facilities. But this is not so. The journey to Washington is usually a mere waste of time and money; but, notwithstanding, some persons prefer to go. A good agent must be employed after the inventor gets there. No one can possibly have facilities or influence superior to our own; a very large portion of the entire business of the Patent Office passes through our hands; and we have an office in Washington, charged with the especial duty of watching over and pressing forward the interests of our clients.

The Patent Office does not prepare patent papers, or make models. These must be provided by the applicant or his attorney, according to law, otherwise his claim will not be considered.

The law especially requires that all documents deposited in the Patent Office shall be correctly, legibly, and clearly written, and that the drawings shall be of a specified size, and executed in an artistic manner.

Persons who visit Washington in person can have all their patent business promptly attended to, by calling at MUNN & Co.'s BRANCH SCIENTIFIC AMERICAN OFFICE, corner of



BRANCH OFFICE OF THE SCIENTIFIC AMERICAN, AT WASHINGTON.—(See page 25.)

Seventh and F streets, opposite the Patent Office. (See engraving opposite page.)

REJECTED OR DEFECTIVE CASES.

WE (Munn & Co.) give prompt attention to the prosecution of rejected or postponed cases, that have been prepared by the applicant or other agent. Terms very moderate.

CAVEATS.

THE filing of a Caveat is sometimes of great importance, as it may be quickly done, and affords *immediate protection* against the issue of a patent, without the knowledge of the Caveator, to any other person for the same invention. The object of a Caveat is to give the inventor time to test and perfect his discovery. Should a competitor apply for a patent for the same invention, the Caveator is officially notified, and called upon to file in his application for a patent. The existence of a Caveat is one of the evidences of priority of invention. A Caveat runs for a year, and can be extended from year to year. Caveats can only be filed by citizens of the United States, and aliens who have resided here one year and have declared their intention to become citizens. All Caveats are secret. No one can see or obtain a copy of a Caveat without the order of the Caveator. A Caveator can use the stamp, "Caveat filed;" and such stamp sometimes assists in selling an article, or securing trade.

But the filing of a Caveat does not secure any *exclusive* right of sale. The Patent secures that right. The filing of a Caveat has nothing to do with the grant of a patent. The Government makes no search as to novelty when a Caveat is filed. No portion of the money paid for a Caveat applies toward the patent.

A Caveat consists of a Petition, Specification, Drawing, and Affidavit of Invention. To be of any value, these papers should be carefully drawn up, and the official rules scrupulously complied with. No model is required. Our facilities enable us to prepare Caveat papers with great dispatch. When specially desired, we can have them ready to send to the applicant, for signature and affidavit, by return mail, or at an hour's notice. The whole expense to file a Caveat is generally \$25, of which the official fee is \$10, and we generally charge \$15 to prepare the papers and attend to the business. On filing the Caveat in Washington the Patent Office issues an Official Certificate thereof, which we forward to the applicant. To enable us to prepare Caveat papers, all that we need is a sketch, drawing, or photograph,

and description of the invention, with which remit fees as above. Model not required.

APPEALS.

WHEN the examiner refuses to allow a patent, and finally rejects the case, we report the fact to our client, and inform him as to the probabilities of obtaining a reversal of the examiner's decision by appeal.

Three appeals are allowed, namely: to the Examiners-in-Chief, to the Commissioner of Patents, to the Supreme Court of the District.

First Appeal.—The Government fee payable by the applicant, on making an appeal to the Examiners-in-Chief, is \$10. Our charges for preparing and conducting this appeal are very moderate, and in part contingent upon success.

Second Appeal.—From the decision of the Examiners-in-Chief an appeal may be taken to the Commissioner of Patents. Government fee, \$20.

Third Appeal.—From the decision of the Commissioner of Patents an appeal may be taken to the Supreme Court of the District of Columbia.

REISSUE OF PATENTS.

WHENEVER any mistake, defect, or insufficiency in the claims or specification of a patent are found to exist, a petition for a reissue may be filed in the Patent Office, together with new drawings and corrected specifications. A new corrected patent will then be issued, and the old patent cancelled. Messrs. Munn & Co. have had thirty years' experience in obtaining reissues, and will be happy to give further information upon the subject, by letter, to all who wish to have their patents corrected.

INFRINGEMENTS.

THE general rule of law is, that the first original patentee is entitled to a broad interpretation of his claims. The scope of any patent is therefore governed by the inventions of prior date. To determine whether the use of a patent is an infringement of another generally requires a most careful examination of all analogous prior patents and rejected applications. An opinion based upon such research requires for its preparation much time and labor. The expense of these examinations, with written opinion, varies from \$25 to \$100 or more, according to the labor involved. Address Munn & Co., 37 Park Row, New York.

Infringements occur much less frequently than most people suppose; and in general, unless you have special reason to

believe that infringement exists, the best way is not to give yourself trouble about it until some one troubles you. Infringement consists in the use, sale, or manufacture of something already patented. It is not an infringement to take out a patent for an invention which is an improvement on a previous patent. It is not an infringement to own, to buy, or to sell any patent. It is not an infringement to sell rights under any patent, whether town, county, or State rights, or licenses.

All good improvements are worth patenting, even if their use should be found to infringe a prior patent. Only a few, comparatively, of the large number of patents issued prove to infringe; and the infringing device is sometimes worth more than the patent with which it conflicts. Patentees of conflicting inventions can usually make satisfactory arrangements with the owners of the prior patents; it is obviously to the interest of prior patentees to have their patents used as extensively as possible. The princely revenue of Howe, the inventor of the sewing-machine, was about \$500,000 annually, derived chiefly from two infringing patentees, paying him a small royalty on each machine. The net profits divided among the owners of one of these infringing patents—the celebrated Wheeler & Wilson—are reported to be more than \$1,000,000 a year. The profits of the other, the Singer Manufacturing Co., are reported at from \$2,000,000 to \$3,000,000 a year.

ASSIGNMENTS OF PATENTS.

If you desire to have an assignment of a patent, or any share thereof, or a license, made out in the proper manner, and placed on record, remit five dollars, give full names of parties, residences, title of invention, date of patent. The above charge includes the recording fee.

Inventions or shares thereof may be assigned either before or after the grant of a patent. Agreements and contracts in regard to inventions should be recorded, like assignments, at Washington.

If you desire to know in whose name the title to a patent is officially recorded at Washington; or if you wish for an abstract of all the deeds of transfer connected with a patent, send us the name of the patentee, or date or number of patent, and remit five dollars.

We (MUNN & Co.) have branch offices in Washington, and have constant access to all the public records. We can therefore make for you *any kind of search*, or look up for you *any sort of information* in regard to patents, or inventions, or

applications for patents, either pending or rejected, that you may desire.

PATENTS FOR ORNAMENTAL DESIGNS.

THE laws for the grant of patents for new designs are of the most liberal and comprehensive character, and their benefits may be enjoyed by all persons, without distinction as to nationality.

Foreign designers and manufacturers who send goods to this country may secure patents here upon their new patterns, and thus prevent other makers from selling similar goods in this market.

A patent for a design may be granted to any person, whether citizen or alien, who, by his own industry, genius, efforts, and expense, has invented or produced any new and original design for a manufacture, bust, statue, alto-relievo, or bass-relief; any new and original design for the printing of woollen, silk, cotton, or other fabrics; any new and original impression, ornament, pattern, print, or picture, to be printed, painted, cast, or otherwise placed on or worked into any article of manufacture; or any new, useful, and original shape or configuration of any article of manufacture, the same not having been known or used by others before his invention or production thereof, or patented or described in any printed publication, upon payment of the duty required by law, and other due proceedings had the same as in cases of inventions or discoveries.

Patents for designs are granted for the term of three and one half years, or for the term of seven years, or for the term of fourteen years, as the said applicant may elect in his application. The patent expires at the end of the term for which it is first granted. No extension.

Design patents are not granted for mechanical or other inventions; but only for ornamental productions; here the scope of the design patent law is very broad. The patentee of a machine may, in addition to the protection of an ordinary patent, also obtain a design patent upon any new ornaments or ornamental forms used on his device. Authors of new inventions should fortify themselves as far as possible by securing design patents; also by securing trade-mark registration.

The personal presence of the applicant is not necessary in order to obtain a design patent, as the business can be done by correspondence. Those who reside at a distance should send us their names in full, middle name included, together with twelve photographs of the design not mounted. Also remit the fees as above, by draft, check, or postal order. We

will then prepare the petition, oath, and specification, and forward the same to the applicant for signature. On their return by him, the papers are filed at the Patent Office, when an official examination is made, and if no conflicting design is found to exist, a patent is issued. The photographs only need to be large enough to represent clearly all the features of the design.

The petition, oath, specification, assignments, and other proceedings in the case of applications for letters-patent for a design are the same as for other patents.

City residents, by calling at our office, can have all the business promptly attended to.

The expenses for design patents are as follows :

Patent for three and a half years, whole expense, \$25.

Patent for seven years, whole expense, \$30.

Patent for fourteen years, whole expense, \$45.

The above includes Government fees and agents' charges.*

Address Munn & Co., 37 Park Row, N. Y.

It has been held in recent official decisions that the applicant for a design patent must exhibit originality in some part of his design, otherwise a patent cannot be supported. The mere imitation of an existing form or configuration of a manufactured article will not support a patent. But an original combination of known ornamental configurations may be patented.

COPIES OF PATENTS.

ON receipt of one dollar, we (Munn & Co.) will furnish a copy of the claim of any United States patent granted since 1828, or the full copy of the specification and drawings of any patent issued since 1872, provided the name of patentee and year of the patent is furnished to us ; but if we have to search for this information, our charge for the search is five dollars.

CLOTH IS MADE FIRE-PROOF nearly, by mixing tungstate of soda with common starch, which is applied in the usual manner, and the cloth then dried in the sun.

Tungsten is a very hard metal, infusible, of iron-gray color, twice as heavy as iron. It is found in the mineral known as wolfram; tungstate of soda is made by fusing wolfram with carbonate of soda.

* The Government fee is \$10 for three and a half years, \$15 for seven years, and \$30 for fourteen years. Our (Munn & Co.'s) charges are \$15. When it is inconvenient for applicants to furnish their own drawings or photographs, we can supply them at a reasonable cost.

TRADE-MARKS.

THE patent law provides that any person, firm, or corporation may secure an exclusive right to use a trade-mark, by complying with the official regulations of the Patent Office. The whole expense is forty dollars.

Trade-marks already in use, no matter for how long a time, may be registered; also trade-marks intended for future use. The proprietor of a registered trade-mark may put it in use whenever he desires.

A trade-mark consists of a distinctive or special name or title for an article, or a device, design, or stamp, or combination thereof, applied to merchandise or the envelopes or packages thereof. But the mere business name of a person or firm is not registerable as a trade-mark.

The official rules must be carefully observed. A petition is to be signed by the applicant, together with a written description of the trade-mark, statement, and declaration as to use, affidavit thereto; a copy of the trade-mark is to be furnished, drawn or mounted on drawing-paper, with twelve copies not mounted.

Trade-marks remain in force for thirty years, and may be renewed for thirty years more. It is unlawful for any person to use any registered trade-mark, or to make such a resemblance thereof as is calculated to deceive. But a trade-mark registered for use upon one particular class of merchandise—hardware goods, for example—will not prevent registration of a similar mark, by another person, for use upon an entirely different class of merchandise—crocery goods, for example.

Those who desire to secure protection for trade-marks are requested to communicate with Munn & Co., No. 37 Park Row, New York, who make it a part of their business to prepare the papers and attend to the application before the Patent Office.

All the business is speedily done. Registration is generally granted within ten days after the papers are filed. City residents should call at our office. Those who live at a distance should give us, in a letter, the following information:

1. The names of the parties who own the trade-mark, their residence and place of business.
2. State the class of merchandise and the particular description of goods in connection with which the trade-mark is to be used.
3. Describe the particular mode in which the trade-mark has been and is intended to be applied and used. For example, for a trade-mark for sheetings the statement would be, "The trade-mark is to be printed in blue ink upon the

outside of each piece of sheeting." Or, "The trade-mark is to be printed in black, or red, white, and blue, upon the exterior of a paper wrapper, which is to cover or extend around each package of the goods." In the use of a trade-mark the owner is not confined to such particular colors or precise method of use; but in the application he must set forth, as above, one or more of the intended methods.

4. State whether the trade-mark is already in use, and if so, how long it has been used.

5. Send us twelve copies of the trade-mark.

Also remit at the same time \$40 in full for the expenses, of which \$25 are for Government fees and \$15 Munn & Co.'s charge.

We will then prepare the necessary petition, declaration, and affidavit for signature by the applicant, and, shortly after filing the papers in the Patent Office, the official certificate will be forwarded to him.

The right to the use of any trade-mark is assignable by an instrument of writing, and such assignment, to insure its validity, should be recorded in the Patent Office within sixty days after its execution.

For assignments, searches of trade-marks, etc., address Munn & Co., 37 Park Row, New York.

DECISIONS.—The word "star," if registered as a trade-mark, is infringed by the use of the figure of a star, and *vice versa*.

As a rule, a geographical name can not be registered as a trade-mark, but may become so when not descriptive. For example, the words "German Syrup" held to be a lawful trade-mark.

Trade-marks such as the following may be registered: For tobacco plugs, "Andrew Jackson;" for military goods, "Smith & Co.," combined with the figure of two crossed swords; for cigars and tobacco, the letters "B. C.," no matter how arranged; for a medical compound, the words "Great American;" for the same, "Bennington's," with a portrait of Dr. Bennington; for shirtings, the figure of a peacock; for dry-goods, the words "There's millions in it;" for pickles, the words "Thunder and Lightning;" for edge-tools, the word "Washoe;" for pianoforte, the word "Weber;" for soap or cosmetic, the word "Hypatia."

ON smooth ice on Hudson River, velocity of wind only ten miles per hour, the best ice-boats sail sixty miles per hour, or six times faster than their wind.

COPYRIGHTS FOR LABELS AND PRINTS.

LABELS and prints of all kinds, for bottles, boxes, and packages, for medicines, compounds, and every description of merchandise, may now be secured by copyright registration in the Patent Office.

In order to obtain such registration, the applicant should write to MUNN & Co., 37 Park Row, New York, give his full name, and send *six copies* of the label or print, together with sixteen dollars, which covers all expenses.* On receipt thereof, we will prepare and file the necessary papers in the Patent Office, and forward the Official Certificate of Registration to the applicant. The whole business only occupies a few days' time.

The patent or registration so obtained lasts for twenty-eight years, and may be then renewed for an additional period of fourteen years. It secures to the proprietor the exclusive right to use the registered label or print during the periods named.

Copyrights for labels and prints may be assigned. The assignments should be recorded. Messrs. MUNN & Co., 37 Park Row, New York, attend to the business.

By the word "*label*," as used in the Act of Congress, is meant a slip or piece of paper, or other material, to be attached in any manner to manufactured articles, or to bottles, boxes, and packages containing them, and bearing an inscription (not a trade-mark), as, for example, the name of the manufacturer, or the place of manufacture, the quality of goods, directions for use, etc.

By the word "*print*," as used in the said Act, is meant any device, picture, word or words, figure or figures (not a trade-mark), impressed or stamped directly upon articles of manufacture, to denote the name of the manufacturer, or place of manufacture, style of goods, etc.

But no such print or label can be registered unless it properly belong to an article of commerce, and be as above defined; nor can the same be registered as such print or label when it amounts in law to a technical trade-mark.

The average velocity of light is 185,000 miles per second.

The light from the sun occupies $8\frac{1}{4}$ minutes in travelling to the earth, the distance being ninety-two millions of miles. The light of the fixed star "Sirius," supposed to be the nearest of the stars, is $3\frac{1}{4}$ years in reaching the earth, the distance being over twenty millions of millions of miles.

* The Government fee is \$6, and our charge (MUNN & Co.'s) is \$10.

COPYRIGHTS FOR BOOKS, PAMPHLETS, CHARTS,
PICTURES, AND ART WORKS.

ANY citizen or resident of the United States may obtain a copyright who is the author, inventor, designer, or proprietor of any book, map, chart, dramatical or musical composition, engraving, cut, print, or photograph or negative thereof, or of a painting, drawing, chromo, statue, statuary, and of models and designs, intended to be perfected as works of the fine arts.

A copyright is not valid unless the title or description is recorded in the Library of Congress *before the publication of the work.*

Those who desire to obtain copyrights are requested to communicate with Munn & Co., No. 37 Park Row, New York, and send us *the title* of the book, print, photograph, or article. We will then cause the title to be printed, and recorded at Washington, as by law required. The official certificate of copyright will then be immediately sent to our client. Our charge to attend to the business of obtaining a copyright is \$5, which please remit with the title. Copyrights are filed in advance of the issue of the work; therefore we only need to receive from the applicant *the intended title* of his production, not the work itself.

If a copyright is desired for a painting, drawing, chromo, statue, statuary, or model or design for a work of art, send us the intended title and also a brief description thereof and \$5.

Copyrights are granted for the term of twenty-eight years, and may be renewed for fourteen additional years, if the renewal is filed within six months before the expiration of the first term.

Copyrights may be assigned; the assignment must be recorded by the Librarian of Congress.

Foreigners who are not residents of the United States cannot obtain copyrights; but if residents, they may obtain copyrights.

Labels for goods, bottles, etc., may be copyrighted. Cost, \$16. See page 32. But machines and inventions cannot be copyrighted.

Address Munn & Co., 37 Park Row, New York, for further information.

The intensity of illumination on a given surface is inversely as the square of its distance from the source of light. If the page of a book held twelve inches from a candle be moved six inches nearer, the light on the page is made four times stronger.

QUESTIONS AND ANSWERS.

OUR extended experience of over thirty years in connection with THE SCIENTIFIC AMERICAN makes our establishment a sort of factotum for the receipt of and reply to questions of all kinds. Thousands of these questions are answered, generally, in THE SCIENTIFIC AMERICAN, to which everybody who desires to be well informed should subscribe. There are still other questions of a special or personal nature to which written replies by mail are desired by our correspondents.

"Myself and friend wish to join in manufacturing a patented article, and form a company. How shall we proceed? How ought the patent deeds to be arranged?"

"Can a patent be attached and sold for debt by sheriff, like other personal property?"

"Suppose three parties own each one third of a patent. Questions: (1) Is not each owner entitled to one third of the profits made by the other owners? (2) Can one owner of a patent make, sell, and use, and grant rights to others, without consent and without accounting to the other owners?"

"If I assign a patent in full, with the verbal understanding that the purchaser is to make certain payments, am I not entitled to recover back my patent if he fails to pay? If not, what is my remedy?"

"I send you herewith copy of an assignment of a patent made to me. Please state whether it is correctly drawn."

"I own the right for the State of New York for the washing machine patented by John Doe, July 4, 1876. Question: Has the original patentee, or other person, the right to make the machines in some other State and fill orders for machines to be used in this State?"

To questions like the above, or those of a kindred nature, we are always ready and willing to send brief written replies, provided correspondents are thoughtful enough to inclose a small fee in recognition of the service. This should not be less than from one to five dollars. If we find that we are unable to give the information requested, we return money. Address Munn & Co., 37 Park Row, New York. Questions relating to *patent infringements* can not be thus answered; see page 26.

Never, under any circumstances, assume a responsibility you can avoid consistently with your duty to yourself and others.

Never relate your misfortunes, and never grieve over what you cannot prevent.

RIGHTS OF EMPLOYERS AND EMPLOYEES.

THE Supreme Court of the United States, in the case of the Union Paper Collar Company (*Official Gazette*, 1875), decides substantially as follows in respect to the rights of employers and employes, touching the proprietorship of new inventions:

Where a person has discovered a new and useful principle in a machine, manufacture, or composition of matter, he may employ other persons to assist in carrying out that principle; and if they, in the course of experiments arising from that employment, make discoveries auxiliary to the plan and preconceived design of the employer, such suggested improvements are, in general, to be regarded as the property of the party who discovered the original principle, and they may be embodied in his patent as part of his invention. Doubt upon that subject can not be entertained.

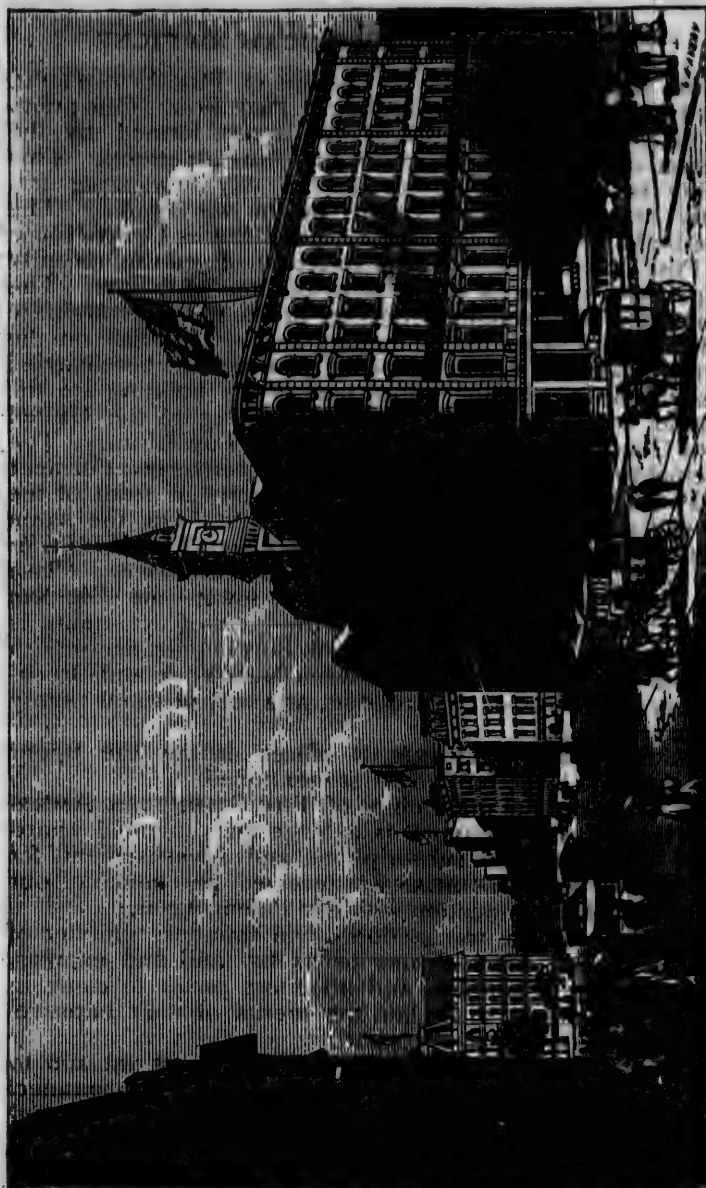
But persons employed as much as employers are entitled to their own independent inventions; and if the suggestions communicated by the persons employed constitute the whole substance of the improvement, the rule is otherwise, and the patent, if granted to the employer, is invalid, because the real invention or discovery belongs to the person who made the suggestions.

The doctrine held by the Patent Office is that an inventor who is an employer has the right to avail himself of the mechanical skill of those whom he employs to put his invention into practical form. If the inventor-employer gives general directions to his workmen to produce a certain machine, the combination or parts, or arrangement produced, belongs exclusively to the inventor-employer, and the workman has no patentable right therein.

But when a workman himself suggests and invents an improvement, without previous direction from his employer, the invention belongs to the workman; he can patent it, and the employer has no claim thereon, although the device may have been made in the shop of the employer, with his tools, and during time belonging to him.

BE neither lavish nor niggardly; of the two, avoid the latter. A mean man is universally despised, but public favor is a stepping-stone to preferment; therefore, generous feelings should be cultivated.

THE speed of an electric spark, travelling over a copper wire, has been ascertained by Wheatstone, to be two hundred and eighty-eight thousand miles in a second.



360 THE SCIENTIFIC AMERICAN OFFICE, NEW YORK, NO. 37 PARK ROW—OPPOSITE THE POST OFFICE.

model rooms, shown in the engraving. All models are
 arranged out in the street, and at night

THE SCIENTIFIC AMERICAN OFFICES.

OUR engraving shows the location of THE SCIENTIFIC AMERICAN office, New York, No. 37 Park Row. Our premises extend across the front of the square formed by the junction of Park Row, Beekman and Nassau streets. This locality is the head-quarters of the city newspaper fraternity and the business centre of the metropolis. The large building at the left is the United States Court-House and Post Office, a magnificent structure of granite, recently completed at a cost of about eight millions of dollars. The other side of this building fronts on the famous thoroughfare of Broadway. This is the largest local Post Office on the continent, and the extent of postal transactions here carried on is enormous. In the upper part of the building are the splendid court-rooms and offices pertaining to the United States Court, Marshals' Offices, and great Law Library. The principal lines of city street railways all converge at or near the Post Office, and the cars pass directly in front of the doorway of THE SCIENTIFIC AMERICAN. On the same block with our offices are those of *The Times*, *The World*, *The New-York Observer*, and other celebrated newspapers. Close by is *The Tribune* office, with its tall tower, and *The Sun* office. The large building seen at the head of the square is the *Zeitung* office. At this point will be the entrance-way to the great Suspension Bridge between New York and Brooklyn, now in process of construction, at a cost of about twenty millions of dollars.

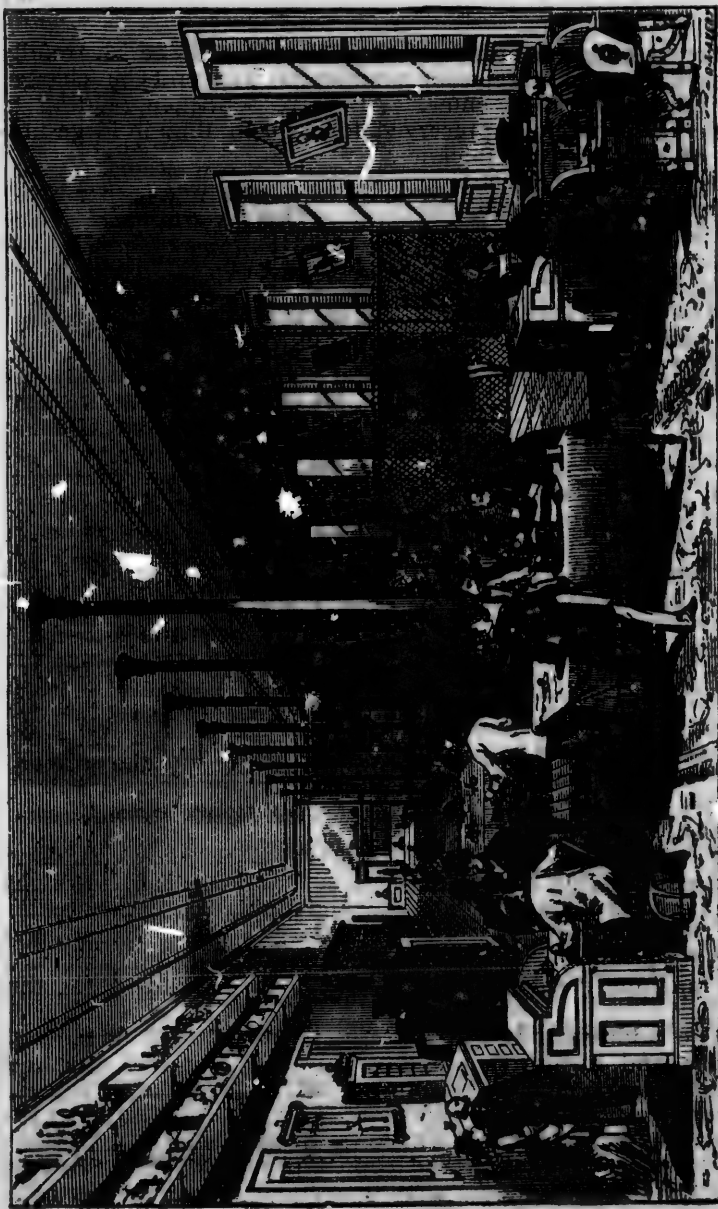
THE SCIENTIFIC AMERICAN offices occupy the upper portions of the large building first mentioned.

The interior of the main office of THE SCIENTIFIC AMERICAN (shown on next page) is a large and splendid apartment. It is here that subscriptions and advertisements for THE SCIENTIFIC AMERICAN are received, and much of our business done in connection with our Patent Agency.

In addition to the transaction of an immense amount of patent business, which comes to us by mail and express, large numbers of authors and inventors prefer to come in person to our offices to explain the merits of their improvements.

In carrying on our extensive patent business we aim to conduct it in the most expeditious and systematic manner. We are assisted by the most experienced examiners and specification writers. The finest mechanical draughtsmen in the country prepare our drawings.

Adjoining our main office, on the same floor, are our model-rooms, shown in the engraving. All models are



38 INTERIOR OF THE SCIENTIFIC AMERICAN OFFICE, NEW YORK.—(See page 37.)

ticketed with the names of their owners, and here carefully stored; no one, except our confidential assistants in charge, being permitted to enter. All correspondence relating to patents is carefully preserved for a given time in large fire-proof safes of extra thickness.

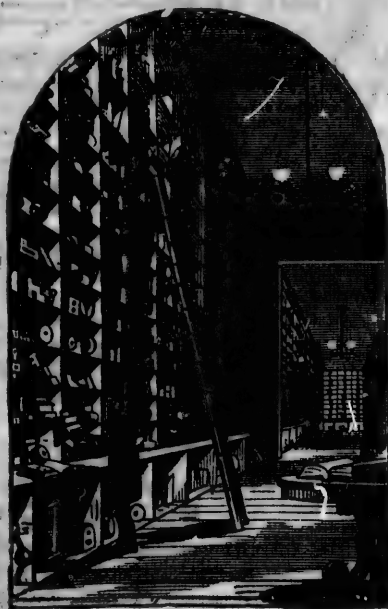
All drawings of pending patent cases are likewise preserved in similar safes, specially made for us for this purpose.

The utmost care is taken to guard the privacy and preserve the safety of the many thousands of inchoate inventions committed to our care; and we may here mention with satisfaction the fact that during our long professional career of over thirty years, not one of our clients has ever found his confidence in us misplaced.

The remaining divisions of our main establishment in New York are the type-room and the editorial-rooms where the interesting matter that fills the pages of THE SCIENTIFIC AMERICAN is prepared.

The printing of THE SCIENTIFIC AMERICAN is done in a neighboring building, where several large steam presses are kept in constant motion, day and night, during the greater part of each week, to work off our large edition. After leaving the press the sheets pass through a folding-machine, are by machinery then trimmed, and then enveloped for the mail.

The addresses of our subscribers are printed on slips of paper, and, during the mailing operation, cut and attached by means of a curious little instrument to the separate copies. The regular combined edition of THE SCIENTIFIC AMERICAN and SCIENTIFIC AMERICAN SUPPLEMENT at present averages sixty-five thousand copies, printed weekly. Advertisers in the two papers may thus have the advantage of a very large circulation. Regular subscribers receive the paper free of postage, which is paid by us. The terms of sub-



THE MODEL ROOM.

40 OUR BRANCH OFFICE IN WASHINGTON.

scription to **THE SCIENTIFIC AMERICAN** are \$3.20 a year. It is sold by single numbers by all news dealers; 10 cents per number. Specimen copies can also be had by sending 10 cents to Munn & Co., 37 Park Row, New York.

OUR BRANCH OFFICE IN WASHINGTON.

WE have a large office in Washington, located at the corner of F and Seventh streets, diagonally across the street from the Patent Office, as shown in the engraving, p. 24.

The first building on the right is the United States Patent Office; the next on the same side is the General Post Office; on the left stands **THE SCIENTIFIC AMERICAN** office. Our location is especially convenient for the transaction of business. We employ at Washington a corps of trained assistants, part of whom make it their exclusive duty to watch and assist the progress of our cases before the Patent Office. For these services we make no extra charges.

Another division of our helpers in Washington devote themselves to the preliminary examination of inventions—a matter that is explained more fully on page 17.

It is to the systematic method and abundant supply of trained helpers, personally supervised by the proprietors, that the long-continued prosperity and remarkable success of **THE SCIENTIFIC AMERICAN** Patent Agency are due.

NO TAXES ON PATENTS.

THE patent and all its rights are under the owner's control; and after a patent is issued it is not subject to additional payments or to taxes of any kind, whether national, State, or local.

WILL IT PAY?

ON page 16 readers are informed that we are always happy to give them our opinion as to the novelty of their inventions, *without charge*. But some persons, when they send for such information, add many other inquiries, difficult to answer, and not included in our gratuitous invitation; as for example: "What is it worth? Who will buy? Will it pay? Does it infringe? Does it conflict with B's patent? If you will guarantee it does not infringe, I will apply for a patent," etc.

The following hints may prove useful as a sort of general answer.

"What is it worth? Who will buy?" As a general rule, an invention is worth little or nothing until the patent is obtained; and until then no one is likely to buy. Therefore the first thing to be considered, the first step to be taken, is to *obtain the patent*.

"Will it pay?" As a general rule, every patentable improvement will more than repay the small cost of taking out the patent. The sale of a single machine, or of a single right of use, will often bring back more than the whole outlay for the patent. The extent of profit frequently depends upon the business capacity of the inventor or his agent. One man by his activity will make a fortune from an unpromising improvement, while another, possessing a brilliant invention, will realize little or nothing, owing to incompetence.

SOUND

Is the effect produced upon the ear when air is set in motion within certain limits of rapidity. Audible sound begins when about thirty-two vibrations per second are made, and ceases when about 40,000 vibrations per second are reached. In an organ, the deepest note has thirty-two vibrations per second, the highest, 3480. The compass of the human voice is, on an average, about two octaves. Deep F of a bass singer has 37 vibrations per second; upper G of treble, 775.

The number of vibrations corresponding with the middle C of a musical instrument is 522 per second. An octave below, half the number; an octave above, twice the number.

Sound travels at the rate of 1100 feet per second in a still atmosphere. The distance in feet between an observer and the point where a stroke of lightning falls, may be known by multiplying 1100 by the number of seconds that elapse after the flash is seen until the sound is heard.

MELTED snow produces from $\frac{1}{8}$ to $\frac{1}{4}$ of its bulk in water.

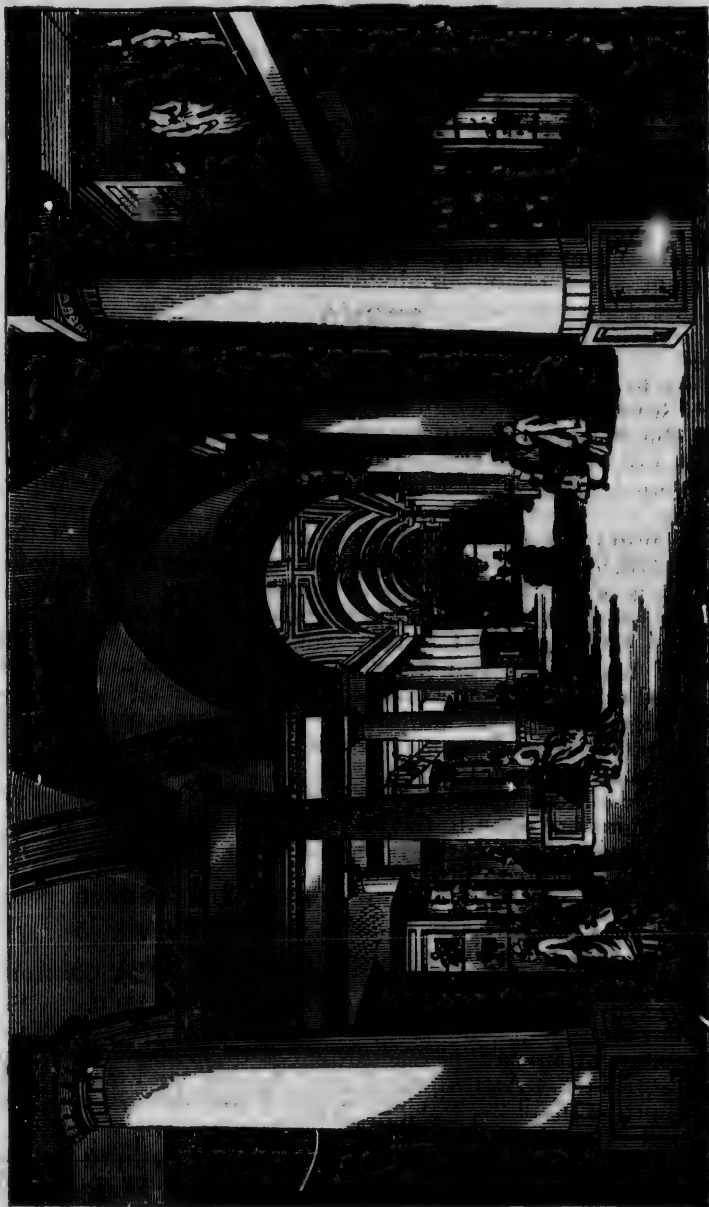
OCEAN waves rise from 20 to 22 feet in extreme height, at which altitude there are 3 in a mile and 4 per minute.

THE highest heat of a common wood fire is estimated at 1140° F.

NEARLY all solids become luminous at 800 degrees of heat F.

THE force of expansion of solids by heat is enormous. Thus iron, if heated from 32° F. to 212°, expands .0012 of its length, to produce which change of length by mechanical means would require a force of 15 tons.

THE best engines and boilers develop a horse-power per hour by the consumption of two pounds of coal. But this is better than the average; and three pounds of coal per horse-power, per hour, is a more common result.



MODEL-HALL, UNITED STATES PATENT OFFICE, WASHINGTON.

THE PATENT OFFICE AT WASHINGTON.

WE present three engravings illustrative of the Patent Office. In the picture given on page 24, the first building seen at the right is the northerly front of the Patent Office, on Seventh street, diagonally opposite THE SCIENTIFIC AMERICAN Patent Agency. The situation of our premises is so remarkably convenient that we are enabled to transact a large amount of patent business very quickly. As all models, drawings, specifications, trade-marks, records of assignments, etc., are deposited in the Patent Office, we have access thereto, on behalf of our clients, by simply stepping across the street.

Next to the Patent Office, on the right, directly opposite THE SCIENTIFIC AMERICAN, is the General Post Office. Here the Postmaster-General sits, and the postal service of the country is regulated. The Post Office building is 304 feet long and 204 feet wide, Corinthian style, of white marble.

The engraving on page 14 shows a full exterior view of the Patent Office, which is one of the finest edifices in Washington. It is of the Doric order of architecture, 433 feet long, 331 feet wide, 75 feet high. The collection of models of inventions here gathered is very remarkable, the aggregate number being over two hundred thousand. Nearly twenty thousand new models are sent to the Patent Office each year.

On page 42 we give an interior view of one of the great model-rooms of the Patent Office, nearly 400 feet long, paved with marble. The models, it will be observed, are deposited in glass cabinets upon the main floor and galleries. The model-rooms are open to the public from 9 A.M. to 3 P.M.

No printed statement or recommendation that we could present will convey to the mind of the visitor so adequate and truthful an impression of the magnitude and wonderful success of our (Munn & Co.'s) labors in procuring patents for inventors as a walk through the Patent Office. The visitor beholds tier upon tier of models, rising on both sides from floor to ceiling, occupying a main portion of the entire building, and finds, on examining the records, that every cabinet, every class of invention, is crowded with models sent from THE SCIENTIFIC AMERICAN Patent Agency, and that a very large portion of all the patents granted are to our (Munn & Co.'s) clients.

The number of persons generally employed at the Patent Office is between four and five hundred. The principal officers are the Commissioner of Patents, who is the executive, the Assistant Commissioner, and seventy examiners.

Their aggregate salaries amount to about one hundred and fifty thousand dollars a year. One hundred and thirty thousand dollars a year, nearly, are paid into the Patent Office by THE SCIENTIFIC AMERICAN Patent Agency alone.

THE LARGEST AND BEST.

Now and then professional rivals, jealous or unreasonable persons, will be found who rail about Munn & Co., usually because we transact so much business and make small charges. These carpers falsely allege that they can do the business better, and afford more time.

Everybody knows, however, that the best service and the most reasonable rates are generally furnished by large, well-conducted establishments, and the patent-agency business is no exception. We have a staff of trained assistants and draughtsmen; we give to every case careful study, experienced care, and *abundance of time*; we have helpers at Washington who make it their special duty to watch over and assist the progress of our cases before the Patent Office, give explanations, and see that the best claims are allowed. No extra charges are made for these services. Our efforts are usually successful and give general satisfaction. For many years we have secured more patents for inventors and done more patent business than the combined business of the majority of the four hundred patent agents in this country. The largest proportion of all the most-valuable and successful patents now existing were obtained through THE SCIENTIFIC AMERICAN Patent Agency.

FOREIGN PATENTS.

THE American patent law contains a special provision for the benefit of the inventor in respect to foreign patents, namely: It provides that after a home patent is allowed, the invention may remain in the secret archives of the Government for a period not exceeding *six months*, if the applicant so desires, thus enabling him to arrange for patents in foreign countries in advance of all other persons.

If the inventor is unable to meet the expenses of the foreign patents, he should find a reliable assistant or partner who will pay the costs and share the profits. Partnerships of this kind have in many cases proved highly profitable to all concerned. Arrangements with one partner for England, another for France, and so on, are suggested.

It is of the utmost importance to the interests of the applicant in taking out foreign patents that he should employ home agents for their procurement, who are well known for responsibility, experience, and integrity. He is thus en-

abled to obtain better service and a better patent, together with prompt information as to the condition of his patent and the steps necessary for its preservation.

CANADA.

THE expense to apply for a Canadian patent is fifty dollars (\$50), which includes Government tax, agency, and all charges for five years, after which two additional terms of five years each may be obtained on payment of fifty dollars each—in all fifteen years. The patent may be applied for at the outset for fifteen years, at a cost of one hundred dollars. Inventions that have been already patented in the United States for not more than one year may be secured in Canada by the inventor, who must sign the papers. If patented for more than one year in the United States the Canadian patent is refused.

In order to apply for a patent in Canada, please send to us (Munn & Co.) a description and drawing of the invention, and remit \$50 in full. If already patented in the United States, a copy of the patent should be supplied. We will then immediately prepare the documents and forward them to the applicant for his signature. His personal presence is unnecessary. All the business can be promptly done by correspondence. The time required to secure the patent is from four to six weeks; the patent is granted without a model, but before the document is actually delivered a small model must be furnished. See page 22.

During the first year of a Canadian patent the holder may import the patented article ready made. Within two years from the date of the patent he must begin the manufacture in Canada, or arrange for some place where persons wishing the invention can order the same. The Canadian patent covers Nova Scotia, Prince Edward Island, and both the Canadas.

GREAT BRITAIN.

THE British patent extends over England, Wales, Scotland, Ireland, and the Channel Islands, but not the Colonies; the latter make their own patent laws.

The expense to apply for an English patent is seventy-five dollars (\$75), which includes Government taxes, agency, and all charges for the first period, or provisional patent, if the invention is not complicated. No models. The patent issues to the first applicant, whether he be the inventor or merely the introducer.

A second instalment of \$175 is payable in New York, three and a half months after the date of the provisional pat-

ent. The patent is then completed and the great seal attached. A third tax is payable three years from date of Patent Certificate; and a final tax at the close of the seventh year. The patent is granted for fourteen years, but ceases if any tax is not duly paid. The patentee in Great Britain possesses the same full and exclusive rights as in the United States.

Great Britain has a population of *forty millions*, and is one of the principal financial, commercial, and manufacturing centres of the world. The importance to our citizens of securing English patents for their new inventions can not be overrated.

FRANCE AND BELGIUM.

THE cost to apply for a French patent is seventy-five dollars (\$75), which covers all expenses until the patent arrives in New York, when a second instalment of \$25 is payable, making in all \$100 for agency and Government taxes for the first year. No official examination is made; no model. The term of the patent is fifteen years, subject to annual tax of \$20. The patent ceases when any due tax is unpaid.

Belgium is the manufacturing centre for a large portion of the Continent, and Belgian patents rank among the most desirable of those that are taken out by American citizens.

The expense to apply for a Belgian patent is seventy-five dollars (\$75). The law and proceedings are substantially the same as in France. When the patent arrives in New York \$25 more are payable, the whole cost being one hundred dollars. A small tax is payable annually. The longest term of the patent is twenty years.

GERMANY AND OTHER COUNTRIES.

IN the following countries the cost of applying for the patent varies with the period of the grant, which may generally be from five to fifteen years, at the option of the applicant. The costs to apply for a patent for the shortest term are: in Prussia, \$100; Austria, \$100; twenty-seven other German States, each \$100; Norway, \$100; Sweden, \$100; Denmark, \$100; Italy, \$150; Russia, \$300; Spain, \$400; Portugal, \$400. No patents granted in Switzerland and the Netherlands.

Patents are also granted in the British Colonies and several of the South American States.

N. B.—We would remind all who desire to take Foreign Patents, that (1) we do the business as low as anybody; (2) we have had over thirty years' experience; (3) the Foreign Patent, when issued, is *noticed without charge* in the *SCIEN-*

TIFIC AMERICAN, which has a large circulation in Europe. This publication is often copied into other papers, and invariably assists the introduction and sale of the patent.

We furnish, *free*, a pamphlet containing additional particulars, and shall be happy to give any other information that may be desired. Address MUNN & Co., Solicitors of American and Foreign Patents, 37 Park Row, New York.

HINTS ON THE SALE OF PATENTS.

THE original study and planning of a new thing is usually a labor of love on the part of the author. The work is suitable for the leisure hour, the winter's evening, the quietude of home. The plan being finished, then comes the business of introduction and sale. The first step in the material progress of the invention is its development into the form of a *public record*, on which the patent issues. This business requires experienced skill for its proper transaction, and the inventor will generally promote his own interests by employing trustworthy solicitors. Not so, however, in respect to the second step, namely, the *making of money* out of the patent. This is a commercial proceeding, involving the ordinary details of industry, prudence, and care. The patentee himself is generally the best manager in this department.

The first thing to be done after receiving a patent is to *make known the merits of the invention as widely as possible*. This is like ploughing and seeding the ground. If well done, the crop will grow, even while the husbandman sleeps.

One of the quickest and most effective methods of bringing the merits of an invention before the public, is to have it noticed and engraved in THE SCIENTIFIC AMERICAN. This paper, published weekly, is seen by probably not less than *three hundred thousand readers*, who comprise all of the most intelligent persons of scientific and mechanical acquirements in the country. The fact of publication in THE SCIENTIFIC AMERICAN is a passport to their attention and favor. "Yes, that is a good invention. I have seen it illustrated in THE SCIENTIFIC AMERICAN, and understand its construction. I advise you to purchase the right." We suppose that more patents are sold upon such advice than by all other agencies and means put together.

The splendid engravings which adorn our paper are prepared by the most talented artists. We are always glad to illustrate new and useful inventions in THE SCIENTIFIC AMERICAN, and, owing to the interest which our readers take in such novelties, we make the expense to the patentee as low

as possible—generally but very little above the actual cost to us. If any one will take the trouble to count the probable cost to him of printing and circulating, by mail, a mass of circulars containing an engraving and description of his invention, and then compare that cost with the insignificant figure he would have to pay us to get up the same cut and description, and *print and circulate fifty thousand copies thereof in THE SCIENTIFIC AMERICAN*, he will appreciate the marvellous economy offered by our journal. The circular plan would cost the patentee more for the *white paper alone*, than we (Munn & Co.) should charge for the entire job. After being electrotyped and published, the original blocks are sent to the owner, who can then use them for other papers, circulars, letter-heads, bill-heads, etc.

Let us here remind the inventor that the value of property in patents is now far greater than in former years, when the population was sparse, and the demand for new manufactures small. Therefore do not part with your patent unless you can realize from it adequately. Any foolish person can give or throw away his property; and we are sorry to say that thousands of valuable patent privileges are wasted by their owners for lack of a little patience.

In general, the best way to begin is to manufacture the article, and also to grant licenses under the patent; unless handsomely paid, avoid the sale of any undivided interest in the proprietorship of the patent, such as a sixteenth, an eighth, or a quarter of the patent. By even one such sale, no matter how small, the patentee loses the control of his patent; under the license plan he does not.

It must not be supposed, because a patent is granted, that the world will run after an unknown man to buy from him an unknown patent. In order to sell licenses or rights under a patent, judicious effort is required on the part of the inventor. Indeed, his final success will depend, to a considerable extent, upon his business tact and energy. He should make himself thoroughly conversant with the merits of his invention, and should prepare specimens or model machines thereof, made in the most perfect manner, so as readily to exhibit the operations of the improvement to others.

A very profitable method of realizing from a patent is to grant town or county licenses, employing good and reliable special agents to travel about and sell them. Such agents expect to make money by the operation, and generally need to have a liberal allowance of the proceeds devoted to their remuneration. In the example of a bee-hive patent, the patentee might issue to the agent, duly signed, a number of county licenses, not good, however, until countersigned by the

agent. Suppose the price for a county is fixed at ten dollars per thousand inhabitants. The agent deposits with the patentee twenty-five dollars or other agreed sum on each license, to be returned if he fails to sell. He, however, sells a county containing 20,000 population for \$200, retains by agreement half the proceeds, or \$100, and returns \$100 to the patentee. The foregoing will be suggestive of many other methods of disposing of patents by special agents, which is usually the most lucrative method of procedure.

In some cases an excellent method is to commence the manufacture of the article in a suitable locality, and when it is so far under way as to exhibit progress and merit, then to sell out the business with license under the patent. This method is often very remunerative.

The patentee may subdivide his patent into as many different classes of rights as he chooses, and sell each class by separate agents or otherwise, as he prefers. Thus, the patentee of a sewing-machine may license one party to sew straw goods, another party to sew cotton goods, another silk, another woollen, etc.

The patentee may, if he desires, require purchasers of his machines to pay him a regular annual rental for the use of the machine, or a tariff upon the goods produced, in addition to the original price of the machine. Thus in the case of the wood-planing machine the patentees required, say, \$5000 to be paid in cash, for which they allowed the licensee to build one machine; and thereafter, for every foot of lumber planed by the machine, the patentee received an additional payment or royalty.

In many of the States general laws exist for the incorporation of manufacturing companies for the development of improved articles. The usual method, where a patent is to form the basis of such a company, is for several persons—three or more—to unite under some agreed title, appoint trustees, president, treasurer, secretary, fixing capital stock at any desired sum, say fifty thousand dollars. The incorporators contribute in money say twenty-five thousand dollars, and take half of the stock; and they issue twenty-five thousand dollars in fully paid-up stock to the patentee, who assigns to the company the agreed right or license under the patent. These companies, if properly managed, are often highly profitable. The patentee should see to it that the required amount of cash capital is actually paid up into the treasury before delivering his assignment, thus insuring the effective working of the invention. Several distinct companies may be organized in this manner, in different places, on the basis of one good patent.

The license and royalty plan is often a most profitable method of employing patents. This, in effect, involves a sort of contract between a patentee and a partner or manufacturer, by which the latter, in consideration of license to make the thing, agrees to pay to the patentee a specified sum for each article made or sold. The patentee of the chimneyspring, now so commonly used to fasten glass chimneys upon lamps, was accustomed to grant licenses to manufacturers on receiving a royalty of a few cents per dozen. His income was at one time reported to be fifty thousand dollars a year from this source. Howe, the inventor of the sewing-machine, received a royalty of from five to ten dollars on each machine, and his annual income was estimated at five hundred thousand dollars. Goodyear, the inventor of vulcanized rubber, divided his patent up into many different rights, licensing one company for manufacturing rubber combs, another for hose-pipes, another for shoes, another for clothing, another for wringers, etc. Each company or partner paid a tariff. Lyall, inventor of the continuous loom, has in like manner divided his patent into many different rights: one company weaves carpets, another corsets, another bags, another sheetings, and so on. He enjoys an enormous income from his invention. We might give many similar examples.

Licenses, shop rights, rights of use, if not exclusive, need not be recorded at Washington. But a grant of an exclusive territorial right, or of an undivided interest in a patent, should be recorded. The business may be quickly done through Messrs. Munn & Co. See page 27.

PROFESSIONAL PATENT-SELLERS.

No sooner does any person's name appear in print as the patentee of a new invention, than he receives, by mail, a shower of letters and circulars, from individuals who set forth that they have remarkable facilities for the selling of patents. The patentee is invited, if he wants to realize immediately, say one thousand, two thousand, or ten thousand dollars, to signify his desire to that effect, and send forward to the agent a *small advance fee*. Thus, instead of helping the patentee to obtain money, they begin by drawing money from him; upon this they live and flourish. We are often asked if these people, who so pressingly and plausibly claim to be able to sell patents, are reliable, and whether they ever effect sales. We regret to be obliged to say that we seldom or never hear of their making any sales. There are twenty thousand new applicants for patents every year, from whom these pretending sellers obtain money. They busy themselves in writing

letters to inventors and in working them up to the remitting point, but have no time left for the drudgery of patent-selling even if they had any ability in that direction. There is no trickery too low for some of these sellers: one concern, for example, has gone so far as to imitate and adopt our long-established firm name of Munn & Co. But we do not sell patents, nor have we connection with any concern that pretends so to do. The truth is, that the profit upon the sales of a single good patent is equivalent to a fortune, and the business it furnishes is enough to fully engage the attention of many persons. Our advice to patentees is: Take hold yourselves of the business of selling. If you want assistance, search for suitable agents among your friends, and interest them specially in your invention.

HOLD THE FORT.

If you have made an invention for which you desire to secure a patent, but lack the necessary funds, do not for that reason be so foolish as to give or to throw away the discovery; do not part with any considerable portion for a pittance; do not, as is so commonly the case, promise or convey a half or any undivided portion of the improvement. If you are pinched for money you can generally, by patience and perseverance, obtain the use of the small sum required, by explaining the merits of the invention to intelligent, reliable persons in your vicinity. To the party who is disposed to make the desired loan, the grant of a privilege for a town or county will generally be a satisfactory recompense, especially if he believes that it will really assist you in the further development of your invention. The following conveyance will, in general, be ample in such cases:

"Whereas I, Richard Roe, of Wyoming, County of Mohawk, State of New York, have invented a new and useful improvement in musical instruments, for which I am about to apply for letters-patent; and whereas John Doe, of Wyoming, New York, hath advanced to me the sum of one hundred dollars towards the expenses of said patent:

"Now this indenture witnesseth, that for and in consideration of said payment to me made, I do hereby grant and convey to the said John Doe, his heirs or assigns, a license to make, use, and sell the invention, within the limits of the County of Mohawk, State of New York, for and during the full end of the term for which said letters-patent are or may be granted. Witness my hand and seal, this first day of January, A.D. 1877.

"In presence of
W. Loe

RICHARD ROE.

STATE LAWS CONCERNING PATENT-RIGHTS.

IN some of the States, laws have been passed by which patentees or their agents who offer *patent-rights* for sale, without complying with certain State regulations, are made liable to fine and imprisonment.

The United States Court, in the case of John Robinson, held that this kind of legislation is unauthorized, that property in inventions exists by virtue of the laws of Congress, and that no State has a right to interfere with its enjoyment, or annex conditions to the grant. If the patentee complies with the laws of Congress on the subject, he has a right to go into the open market anywhere within the United States and sell his property. If this were not so, a State might nullify the laws of Congress and destroy the powers conferred by the Constitution.

All laws of State legislatures that in any manner interfere with the free sale of patent-rights, such as the requiring of the agent or patentee to file copies of patent, take licenses, procure certificates, comply with forms, or which release the payee of ordinary notes of hand given for patents, have been declared unconstitutional and void by the United States Courts.

All State judges, sheriffs, or other State officials who undertake to interfere with patentees or their agents in the free sale of patents, make themselves liable in damages and other punishment.

The decisions of the United States Courts on these points are given in SCIENTIFIC AMERICAN SUPPLEMENT, No. 25. Price 10 cents. To be had at SCIENTIFIC AMERICAN Office, 37 Park Row, and at any news store.

The above decisions apply only to the sale of *patents and rights under patents*, not to the peddling of goods or the sale of manufactured articles. All citizens of the United States must comply with the usual local license laws concerning the sale of goods, whether the goods are patented or not. But no State can lawfully enact a special law adverse to the sale of patented goods, or impose any special restriction, tax, or fine upon persons who go about to sell patented goods or patented articles of any description.

PLATINUM has been drawn into wires only one thirty-thousandth ($\frac{1}{30000}$) part of an inch, invisible to the eye, and one mile's length weighing only one grain.

A CUBIC foot of air weighs 535 grains. Water is 815 times heavier than air. A cubic foot of water weighs 62½ lbs., a gallon 8½ lbs.

ABSTRACT
FROM THE
RULES OF PRACTICE
IN THE
UNITED STATES PATENT OFFICE.

WHO MAY OBTAIN A PATENT.

ANY person, whether citizen or alien, being the original and first inventor or discoverer of any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent for his invention or discovery, subject to the conditions hereinafter named.

In case of the death of the inventor, the patent may be applied for by, and will issue to, his executor or administrator. In case of an assignment of the whole interest in the invention, or of the whole interest in the patent if granted, the patent will issue to the assignee, upon the request of the latter, or his assignor; and so, if the assignee holds an undivided part interest, the patent will, upon a similar request, issue jointly to him and the inventor; but the assignment must first have been entered of record, and at a day not later than the date of the payment of the final fee. The application and oath must be made by the actual inventor, if alive, even if the patent is to issue to an assignee; but where the inventor is dead, the application and oath must be made by his executor or administrator.

Joint inventors are entitled to a joint patent; neither can claim one separately; but the independent inventors of separate and independent improvements in the same machine can not obtain a joint patent for their separate inventions; nor does the fact that one man furnishes the capital and the other makes the invention entitle them to make application as joint inventors.

A patent will not be granted to an applicant if what he claims as new has been, before his invention, patented or described in any printed publication in this or any foreign country, or been invented or discovered in this country, nor if he has once abandoned his invention, nor if it has been in public use or on sale more than two years previous to his application.

If it appears that the inventor, at the time of making his application, believes himself to be the first inventor or discoverer, a patent will not be refused on account of the invention or discovery, or any part thereof, having been known or used in any foreign country before his invention or discovery thereof, it not appearing that the same, or any substantial part thereof, had before been patented or described in any printed publication.

Merely conceiving the idea of an improvement or machine is not an "invention" or "discovery." The invention must have been reduced to a practical form, either by the construction of the machine itself or by such disclosure of its exact character that a mechanic, or one skilled in the art to which it relates, can and does construct the improvement before it will prevent a subsequent inventor from obtaining a patent.

No application for a patent will be regarded as complete, or be placed upon the files for examination, until the fee is paid, the specification, the petition, and the oath, properly signed, are filed, and the drawings and a model or specimens (when required) are furnished.

Two or more separate and independent inventions can not be claimed in one application but where several distinct inventions are dependent upon each other and mutually contribute to produce the new result, they may be so claimed.

DRAWINGS.

The applicant for a patent is required by law to furnish a drawing of his invention, where the nature of the case admits of it. The following rules will therefore be rigidly enforced, and any departure from them will be certain to cause delay in the examination of an application for letters-patent:

a. Drawings should be made upon paper stiff enough to stand in the portfolios, the surface of which must be calendered and smooth. Indian ink, of good quality, to the exclusion of all other kinds of ink or color, must be employed, to secure perfectly black and solid work.

b. The size of a sheet on which a drawing is made should be exactly 10 by 15 inches. One inch from its edges a single mar-

ginal line is to be drawn, leaving the "sight" precisely 8 by 13 inches. Within this margin all work and signatures must be included. One of the smaller sides of the sheet is regarded as its top, and, measuring downward from the marginal line, a space of not less than $1\frac{1}{4}$ inches is to be left blank for the insertion of title, name, number, and date.

c. All drawings must be made with the pen only, using the blackest Indian ink. Every line and letter (signatures included) must be *absolutely black*. This direction applies to all lines, however fine, to shading, and to lines representing cut surfaces in sectional views. All lines must be clean, sharp, and solid, and they must not be too fine or crowded. Surface shading, when used, should be left very open. Sectional shading should be by oblique parallel lines, which may be about one twentieth of an inch apart.

d. Drawings should be made with the fewest lines possible consistent with clearness. By observing this rule the effectiveness of the work after reduction will be much increased. Shading (except on sectional views) should be used only on convex and concave surfaces, where it should be used sparingly, and may even there be dispensed with if the drawing is otherwise well executed. The plane upon which a sectional view is taken should be indicated on the general view by a broken or dotted line. Heavy lines on the shade sides of objects should be used, except where they tend to thicken the work and obscure letters of reference. The light is always supposed to come from the upper left-hand corner, at an angle of forty-five degrees. Imitations of wood or surface-graining should not be attempted.

e. The scale to which a drawing is made ought to be large enough to show the mechanism without crowding, and two or more sheets should be used if one does not give sufficient room to accomplish this end; but the number of sheets must never be increased unless it is absolutely necessary. It often happens that an invention, although constituting but a small part of a machine, has yet to be represented in connection with other and much larger parts. In such cases a general view on a small scale is recommended, with one or more of the invention itself on a much larger scale.

f. Letters of reference must be well and carefully formed; they are of the first importance. When at all possible, no letter of reference should measure less than one eighth of an inch in height, that it may bear reduction to one twenty-fourth of an inch, and they may be much larger when there is sufficient room.

Reference letters must be so placed in the close and complex parts of drawings as not to interfere with a thorough

comprehension of the same, and to this end should rarely cross or mingle with the lines. When necessarily grouped around a certain part, they should be placed at a little distance, where there is available space, and connected by short broken lines with the parts to which they refer. They must never appear upon shaded surfaces, and, when it is difficult to avoid this, a blank space must be left in the shading where the letter occurs, so that it shall appear perfectly distinct and separate from the work. If the same part of an invention appears in more than one figure, it should always be represented by the same letter.

The foregoing rules relating to drawings will be rigidly enforced; and all drawing not artistically executed in conformity therewith will be returned to the respective applicants, or, at the applicant's option and cost, the Office will make the necessary corrections.

All reissue applications must be accompanied by new drawings, as in original applications, and the inventor's name must appear in all cases upon the same.

MODELS.

As a rule, a model will not be dispensed with except by recommendation of the examiner. It must clearly exhibit every feature of the machine which forms the subject of a claim of invention, but should not include other matter than that covered by the actual invention or improvement, unless it is necessary to the exhibition of a working model. The model must be neatly and substantially made of durable material, metal being deemed preferable; and should not in any case be more than one foot in length, width, or height. If made of pine or other soft wood, it should be painted, stained, or varnished. Glue must not be used, but the parts should be so connected as to resist the action of heat or moisture. When the invention is a composition of matter, a specimen of the composition, properly marked, must accompany the application. Specimens of the separate ingredients, if ordinary and well known, need not be furnished, unless the Office disputes their operation in the manner as stated by applicant.

THE OFFICIAL EXAMINATION.

All cases in the Patent Office are classified and taken up for examination in regular order; those in the same class

being examined and disposed of, as far as practicable, in the order in which the respective applications are completed. When, however, the invention is deemed of peculiar importance to some branch of the public service, and when, for that reason, the head of some Department of the Government specially requests immediate action, the case will be taken up out of its order. These, with applications for extensions, for reissue, and for letters-patent for inventions for which a foreign patent has already been obtained, which cases have precedence over all others, are the only exceptions to the above rule in relation to the order of examination.

INTERFERENCES.

An "interference" is a proceeding instituted for the purpose of determining the question of *priority of invention* between two or more parties claiming the same patentable subject-matter. It may also be resorted to for the purpose of procuring evidence relating to the alleged abandonment or the public use of an invention.

An interference will be declared in the following cases :

First. When two or more parties have applications pending before the Office at the same time, and their respective claims conflict in whole or in part.

Second. When two or more applications are pending at the same time, in each of which a like patentable invention is shown or described, and claimed in one though not specifically claimed in all of them.

Third. When an applicant, having been rejected upon an unexpired patent, claims to have made the invention before the patentee.

The fact that one of the parties has already obtained a patent will not prevent an interference; for, although the Commissioner has no power to cancel a patent already issued, he may, if he finds that another person was the prior inventor, give him a patent also, and thus place both parties on an equal footing before the courts and the public.

REISSUES.

A reissue is granted to the original patentee, his legal representatives, or the assignees of the entire interest, when, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his invention or discovery more than he had a right to claim as new, the original patent is inoperative or invalid, provided the error has arisen from inadvertence, accident, or mistake, and without any fraudulent or deceptive intention. In the cases of patents

issued and assigned prior to July 8, 1870, the application for reissue may be made by the assignee; but, in the case of patents issued or assigned since that date, the application must be made and the specification sworn to by the inventor, if he be living.

The general rule is, that whatever is really embraced in the original invention, and so described or shown that it might have been embraced in the original patent, may be the subject of a reissue; but no new matter shall be introduced into the specification, nor shall the model or drawings be amended except each by the other; but, when there is neither model nor drawing, amendments may be made upon proof satisfactory to the Commissioner that such new matter or amendment was a part of the original invention, and was omitted from the specification by inadvertence, accident, or mistake, as aforesaid.

Reissued patents expire at the end of the term for which the original patents were granted. For this reason applications for reissue will take precedence, in examination, of original applications.

A patentee in reissuing may, at his option, have a separate patent for each distinct and separate part of the invention comprehended in his original patent, by paying the required fee in each case, and complying with the other requirements of the law, as in original applications. Each division of a reissue constitutes the subject of a separate specification descriptive of the part or parts of the invention claimed in such division; and the drawing may represent only such part or parts. All the divisions of a reissue will issue simultaneously. If there be controversy as to one, the others will be withheld from issue until the controversy is ended.

In all cases of applications for reissues, the original claim, if reproduced in the amended specification, is subject to re-examination, and may be revised and restricted in the same manner as in original applications. The application for a reissue must be accompanied by a surrender of the original patent, or, if lost, then by an affidavit to that effect and a certified copy of the patent; but if any reissue be refused, the original patent will, upon request, be returned to the applicant.

DESIGN PATENTS.

When the design can be sufficiently represented by drawings or photographs a model will not be required.

Whenever a photograph or an engraving is employed to illustrate the design, it must be mounted upon a thick Bristol-board or drawing-paper, ten by fifteen inches in size; and

the applicant will be required to furnish ten extra copies of such photograph or engraving (not mounted), of a size not exceeding seven and a half inches by eleven.

Whenever the design is represented by a drawing, each of the ten copies must be made to conform as nearly as possible to the rules laid down for drawings of mechanical inventions.

ASSIGNMENTS.

A patent or trade-mark may be assigned, either as to the whole interest or any undivided part thereof, by an instrument of writing. No particular form of words is necessary to constitute a valid assignment, nor need the instrument necessarily be sealed, witnessed, or acknowledged.

In every case where it is desired that the patent shall issue to an assignee, the assignment must be recorded in the Patent Office at a date not later than the day on which the final fee is paid.

A patentee may not only assign the whole or an undivided interest in his patent, but he may grant and convey an exclusive right under his patent to the whole or any specified portion of the United States by an instrument in writing.

Every assignment or grant of an exclusive territorial right, as well as of an interest in a patent or trade-mark, must be recorded in the Patent Office; if a patent, within three months, if a trade-mark, within sixty days, from the execution thereof; otherwise it will be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice.

The patentee may convey separate rights under his patent to make or to use or to sell his invention, or he may convey territorial or shop rights which are not exclusive. Such conveyances are mere licenses, and need not be recorded.

The receipt of assignments is not generally acknowledged by the Patent Office; they will be recorded in their turn within a few days after their reception, and then transmitted to the person entitled to them.

The Patent Office can not respond to inquiries as to the novelty of an alleged invention in advance of an application for a patent, nor to inquiries founded upon brief and imperfect descriptions, propounded with a view of ascertaining whether such alleged improvements have been patented, and if so, to whom; nor can it act as an expounder of the patent law, nor as counsellor for individuals, except as to questions arising within the Office.

ATTORNEYS.

Any person of intelligence and good moral character may appear as the agent or the attorney in fact of an applicant, upon filing a proper power of attorney. As the value of patents depends largely upon the careful preparation of the specification and claims, the assistance of competent counsel will, in most cases, be of advantage to the applicant, but the value of their services will be proportioned to their skill and honesty. So many persons have entered this profession of late years without experience that too much care can not be exercised in the selection of a competent man. The Patent Office can not assume responsibility for the acts of attorneys, nor can it assist applicants in making a selection. It will, however, be a safe rule to distrust those who boast of the possession of special and peculiar facilities in the Office for procuring patents in a shorter time or with more extended claims than others.

FORMS.

FORMS OF PETITIONS FOR PATENTS.

By a Sole Inventor.

To the Commissioner of Patents:

Your petitioner, a resident of _____, prays that letters-patent be granted to him for the invention set forth in the annexed specification.

By Joint Inventors.

To the Commissioner of Patents:

Your petitioners, residing respectively in _____ and _____, pray that letters-patent may be granted to them, as joint inventors, for the invention set forth in the annexed specification.

A. B.
C. D.

*By an Inventor for Himself and an Assignee.**To the Commissioner of Patents:*

Your petitioner, a resident of ———, prays that letters-patent may be granted to himself and C. D., of ———, as his assignee, for the invention set forth in the annexed specification, the assignment to the said C. D. having been duly recorded in the Patent Office, in liber —, page —. A. B.

*For a Reissue, (by the Inventor.)**To the Commissioner of Patents:*

Your petitioner, of ———, prays that he may be allowed to surrender the letters-patent for an improvement in coal-scuttles, granted to him May 16, 187 —, whereof he is now sole owner, [or, "whereof C. D., on whose behalf and with whose assent this application is made, is now sole owner, by assignment,"] and that letters-patent may be reissued to him, [or, "the said C. D.,"] for the same invention, upon the annexed amended specification. Accompanying this petition is an abstract of title, duly certified, as required in such cases.

A. B.

Assent of Assignee to Reissue.

The undersigned, assignee of the entire [or an undivided] interest in the above-mentioned letters-patent, hereby assents to the accompanying application.

C. D.

For a Reissue, (by Assignee.)

(To be used only when the inventor is dead, or the original patent was issued and assigned prior to July 8, 1870.)

To the Commissioner of Patents:

Your petitioners, of the city of ———, State of ———, pray that they may be allowed to surrender the letters-patent for an improvement in coal-scuttles, granted May 16, 187 —, to E. F., now deceased, whereof they are now owners, by assignment, of the entire interest, and the letters-patent may be reissued to them for the same invention, upon the annexed amended specification. Accompanying this petition is an abstract of title, duly certified, as required in such cases.

A. B.

C. D.

*For Letters-Patent for a Design.**To the Commissioner of Patents:*

Your petitioner, residing in ———, prays that letters-patent may be granted to him for the term of three and one half years [or "seven years," or "fourteen years,"] for the new and original design set forth in the annexed specification.

A. B.

*For the Registration of a Trade-Mark.**To the Commissioner of Patents :*

Your petitioners respectfully represent that the firm of A. B., C. D. & Co. is engaged in the manufacture of woven fabrics at ———, ———, and at ———, ———, and that the said firm is entitled to the exclusive use, upon the class of goods which they manufacture, of the trade-mark described in the annexed statement or specification, [and accompanying *fac-simile*.]

They therefore pray that they may be permitted to obtain protection for such lawful trade-mark under the law in such cases made and provided.

A. B., C. D. & Co.,

By A. B.

*Petition with Power of Attorney.**To the Commissioner of Patents :*

Your petitioner, a resident of the city of ———, State of ———, prays that letters-patent may be granted to him for the invention set forth in the annexed specification; and he hereby appoints C. D., of the city of ———, State of ———, his attorney, with full power of substitution and revocation, to prosecute this application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

A. B.

Power of Attorney.

If the power of attorney be given at any time other than that of making application for patent, it will be in substantially the following form :

To the Commissioner of Patents :

The undersigned having, on or about the 20th day of July, 187 —, made application for letters-patent for an improvement in a horse-power hereby appoints C. D., of the city of ———, State of ———, his attorney, with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent Office connected therewith.

Signed at ———, and State of ———, this ——— day of ———, 18 —. A. B.

Revocation of Power of Attorney.

The undersigned having, on or about the 26th day of December, 187, appointed C. D., of the city of —, and State of —, his attorney to prosecute an application for letters patent, made on or about the 1st day of June, 1868, for an improvement in the running-gear of wagons, hereby revokes the power of attorney then given.

Signed at —, —, this 21st day of July, 187. A. B.

SPECIFICATION.

To all whom it may concern :

Be it known that I, [here insert the name of the inventor,] of —, in the county of —, and State of —, have invented a new and useful improvement in saw-toothing machines, which improvement is fully set forth in the following specification, reference being had to the accompanying drawings:

The object of my invention is to rapidly form, on the blade of a hand-saw, teeth gradually decreasing in size from the broad to the narrow end of the blade, by the combination, in a saw-toothing machine, of a tapering barrel, E, and a chain, or its equivalent, with rollers, *a a'*, for feeding, or with a slide for carrying the blade A, as shown in the perspective view, Fig. 1, of the accompanying drawing.

The machine is illustrated more in detail in the plane view, Fig. 3, and in the vertical section, Fig. 2, in which it has not been deemed necessary to show the driving mechanism. The blade is held by and between the two upper rollers *a a'* (the latter being a feed roller), and two lower rollers *b b'*, and is made to traverse in the direction of the arrow, at a gradually decreasing speed, by causing a barrel, D, to unwind a chain or its equivalent from a tapering barrel, E, on the shaft B. The several shafts have their bearings in a simple frame, H, the front portion *h* of the latter forming a table, which, in conjunction with the lower rollers, supports the blade, as the latter is caused to traverse with its edges in contact with the adjustable guides *y y'*, on the frame. In this table is a fixed die or anvil, *f*, on which the blade bears, and in which is a triangular notch, corresponding in shape to a punch, *e*, on a rapidly revolving disk, G.

As the blade moves at a gradually decreasing speed in the direction of the arrow, the punch will strike triangular pieces from its edge, and the result will be the formation of the desired graduated teeth.

It will be evident that the driving-barrel, D, may be tapering, and the barrel, E, cylindrical, or that both barrels may

be tapering, and arranged to feed gradually faster instead of gradually slower, with the same result, and that the blade may be clamped to a guided sliding-bed, controlled by a tapering barrel and cord or chain.

I claim as my invention—

The combination in a saw-toothing machine, substantially as described, of a tapering barrel and chain, with a roller for feeding the blade.

A. B.

Witnesses: C. D.

E. F.

AFFIDAVIT OF INVENTION.

By a Sole Inventor.

(To follow specification.)

STATE OF ———, County of ———, ss.:

A. B., the above-named petitioner, being duly sworn (or affirmed), deposes and says that he verily believes himself to be the original and first inventor of the improvement in seed-drills described and claimed in the foregoing specification; that he does not know and does not believe that the same was ever before known or used; and that he is a citizen of ———, and a resident of ———. A. B.

Sworn to and subscribed before me this 13th day of March, 187 ———.

C. D., *Justice of the Peace.*

[If the applicant be an alien, the sentence "and that he is a citizen of the United States" will be omitted, and in lieu thereof will be substituted "and that he is a citizen of the Republic of Mexico," or "and that he is a subject of the King of Italy," or "of the Queen of Great Britain," or as the case may be.

If the applicants claim to be *joint inventors*, the oath will read "that they verily believe themselves to be the original, first, and joint inventors," etc.

If the inventor be dead, the oath will be taken by the administrator or executor, and will declare his belief that the party named as inventor was the original and first inventor.]

Trade-Mark Affidavit.

STATE OF ———, County of ———, ss.:

A. B., being duly sworn, deposes and says that he is a member of the firm of A. B., C. D. & Co., above named; that he verily believes that said firm has the right to the use of the trade-mark described in the foregoing specification, and that no other person, firm, or corporation has the right to such use, either in the identical form or having such near resemblance thereto as might be calculated to deceive; and

that the description and fac-simile presented for record are true copies of the trade-mark sought to be protected, and that he resides in —, and all the other members of the firm reside at —, in the State of —; and that they are all domiciled in —, and are citizens of —.

Sworn to and subscribed before me this 15th day of July, 187 . E. F., *Justice of the Peace.*

PETITION FOR CAVEAT.

The petition of A. B., of —, in the county of —, and State of —, respectfully represents:

That he has made certain improvements in velocipedes, and that he is now engaged in making experiments for the purpose of perfecting the same, preparatory to applying for letters-patent therefor. He therefore prays that the subjoined description of his invention may be filed as a caveat in the confidential archives of the Patent Office. A. B.

SPECIFICATION (for Caveat).

The following is a description of my newly-invented velocipede, which is as full, clear, and exact as I am able at this time to give, reference being had to the drawing hereto annexed.

This invention relates to that class of velocipedes in which there are two wheels connected by a beam forming a saddle for the rider, the feet being applied to cranks that revolve the front wheel.

The object of my invention is to render it unnecessary to turn the front wheel so much as heretofore, and at the same time to facilitate the turning of sharp curves. This I accomplish by fitting the front and the hind wheels on vertical pivots, and connecting them by means of a diagonal bar, as shown in the drawing, so that the turning of the front wheel also turns the back wheel with a position at an angle with the beams, thereby enabling it easily to turn a curve.

In the drawing, A is the front wheel, B the hind wheel, and C the standards extending from the axle of the front wheel to the vertical pivot *a* in the beam *b*, and D is the cross-bar upon the end of *a*, by which the steering is done. The hind wheel B is also fitted with jaws *c* and a vertical pivot, *d*.

Witnesses: C. D.

A. B.

E. F.

[The form of oath will be substantially that provided for original applications, except that, as a caveat can only be filed by a citizen, or an alien who has resided for one year last past in the United States, and made oath of his intention to become a citizen, the oath should be modified accordingly.]

ASSIGNMENTS.

Of an undivided Fractional Interest in an Invention before the Issue of Letters-Patent.

In consideration of one dollar, to me paid by C. D., of ———, I do hereby sell and assign to said C. D. an undivided half of all my right, title, and interest in and to a certain invention in ploughs, as fully set forth and described in the specification which I have prepared [if the application has been already made, say "and filed"] preparatory to obtaining letters-patent of the United States therefor. And I do hereby authorize and request the Commissioner of Patents to issue the said letters-patent jointly to myself and the said C. D., our heirs and assigns.

Witness my hand and seal this th day of February, 187
In presence of A. B.

Of the Entire Interest in Letters-Patent.

In consideration of five hundred dollars, to me paid by C. D., of ———, I do hereby sell and assign to the said C. D. all my right, title, and interest in and to the letters-patent of the United States No. 41,806, for an improvement in locomotive head-lights, granted to me July 30, 187, the same to be held and enjoyed by the said C. D. to the full end of the term for which said letters-patent are granted, as fully and entirely as the same would have been held and enjoyed by me if this assignment and sale had not been made.

Witness my hand and seal this th day of January, 187
In presence of A. B.

Of an Undivided Interest in the Letters-Patent and Extension thereof.

In consideration of one thousand dollars, to me paid by C. D., of ———, I do hereby sell and assign to the said C. D. one undivided fourth part of all my right, title, and interest in and to the letters-patent of the United States No. 10,485, for an improvement in cooking-stoves, granted to me May 16, 187; the same to be held and enjoyed by the said C. D. to the full end of the term for which said letters-patent are granted, and for the term of any extension thereof, as fully and entirely as the same would have been held and enjoyed by me if this assignment and sale had not been made.

Witness my hand and seal this th day of June, 187
In presence of A. B.

Exclusive Territorial Grant by an Assignee.

In consideration of one thousand dollars, to me paid by C. D., of ———, I do hereby grant and convey to the said C. D. the exclusive right to make, use, and vend within the State of ———, and in no other place or places, the improvement in corn-planters for which letters-patent of the United States, dated August 15, 187 , were granted to E. F., and by said E. F. assigned to me December 3, 187 , by an assignment duly recorded in liber X^s, p. 416, of the records of the Patent Office, the same to be held and enjoyed by the said C. D. as fully and entirely as the same would have been held and enjoyed by me if this grant had not been made.

Witness my hand and seal this th day of March, 187 .

A. B.

License—Shop-Right.

In consideration of fifty dollars to me paid by the firm of S. J. & Co., of ———, I do hereby license and empower the said S. J. & Co. to manufacture, at a single foundry and machine-shop in said ———, and in no other place or places, the improvement in cotton-seed planters for which letters-patent of the United States No. 71,846 were granted to me November 13, 187 , and to sell the machines so manufactured throughout the United States to the full end of the term for which said letters-patent are granted.

Witness my hand and seal this d day of April, 187 .

A. B.

License—not exclusive—with Royalty.

This agreement, made this 12th day of September, 187 , between A. B., of ———, party of the first part, and the Uniontown Agricultural Works of ———, party of the second part, witnesseth, that, whereas letters-patent of the United States for an improvement in horse-rakes were granted to the party of the first part, dated October 4, 187 ; and whereas the party of the second part is desirous of manufacturing horse-rakes containing said patented improvement: now, therefore, the parties have agreed as follows:

I. The party of the first part hereby licenses and empowers the party of the second part to manufacture, subject to the conditions hereinafter named, at their factory in ———, and in no other place or places, to the end of the term for which said letters-patent were granted, horse-rakes containing the patented improvements, and to sell the same within the United States.

II. The party of the second part agrees to make full and

true returns to the party of the first part, under oath, upon the first days of July and January in each year, of all horse-rakes containing the patented improvements manufactured by them.

III. The party of the second part agrees to pay to the party of the first part five dollars, as a license-fee upon every horse-rake manufactured by said party of the second part containing the patented improvements; provided, that if the said fee be paid upon the days provided herein for semi-annual returns, or within ten days thereafter, a discount of fifty per cent shall be made from said fee for prompt payment.

IV. Upon a failure of the party of the second part to make returns, or to make payment of license-fees, as herein provided, for thirty days after the days herein named, the party of the first part may terminate this license by serving a written notice upon the party of the second part; but the party of the second part shall not thereby be discharged from any liability to the party of the first part for any license-fees due at the time of the service of said notice.

In witness whereof the parties above named (the said Uniontown Agricultural Works, by its president) have hereunto set their hands the day and year first above written.

In presence of

A. B.
U. A. W.

Transfer of a Trade-Mark.

We, A. B. and C. D., of ———, partners under the firm name of B. & D., in consideration of five hundred dollars to us paid by E. F., of the same place, do hereby sell, assign, and transfer to the said E. F. and his assigns the exclusive right to use in the manufacture and sale of stoves a certain trade-mark for stoves deposited by us in the United States Patent Office, and recorded therein July 15, 1870; the same to be held, enjoyed, and used by the said E. F., as fully and entirely as the same would have been held and enjoyed by us if this grant had not been made.

Witness our hands this 20th day of July, 187 .

In presence of

A. B.
C. D.

Messrs. Munn & Co., 37 Park Row, New York, make it a part of their business to prepare and put on record assignments and agreements relating to patents, trade-marks, copyrights, etc.

THE
PATENT LAWS
OF THE
UNITED STATES.

REVISED STATUTES, FORTY-THIRD CONGRESS, APPROVED JUNE 22, 1874.

ORGANIZATION OF THE PATENT OFFICE—SALARIES—POWERS OF THE COMMISSIONER—PRINTING OF PATENTS, ETC.

TITLE XI., Rev. Stat., sec. 440, p. 74:

There shall be in the Department of the Interior

In the Patent Office:

One chief clerk, at a salary of two thousand five hundred dollars a year.

One examiner in charge of interferences, at a salary of two thousand five hundred dollars a year.

One examiner in charge of trade-marks, at a salary of two thousand five hundred dollars a year.

Twenty-four principal examiners, at a salary of two thousand five hundred dollars a year each.

Twenty-four first assistant examiners, at a salary of one thousand eight hundred dollars a year each.

Twenty-four second assistant examiners (two of whom may be women), at a salary of one thousand six hundred dollars a year each.

Twenty-four third assistant examiners, at a salary of one thousand four hundred dollars a year each.

One librarian, at a salary of two thousand dollars a year.

One machinist, at a salary of one thousand six hundred dollars a year.

Three skilled draughtsmen, at a salary of one thousand two hundred dollars a year each.

Thirty-five copyists of drawings, at a salary of one thousand dollars a year each.

One messenger and purchasing clerk, at a salary of one thousand dollars a year.

One skilled laborer, at a salary of one thousand two hundred dollars a year.

Eight attendants in the model-room, at a salary of one thousand dollars a year each.

Eight attendants in the model-room, at a salary of nine hundred dollars a year each.

SEC. 475. There shall be in the Department of the Interior an office known as the Patent Office, where all records, books, models, drawings, specifications, and other papers and things pertaining to patents shall be safely kept and preserved.

SEC. 476. There shall be in the Patent Office a Commissioner of Patents, one Assistant Commissioner, and three examiners-in-chief, who shall be appointed by the President, by and with the advice and consent of the Senate. All other officers, clerks, and employes authorized by law for the Office shall be appointed by the Secretary of the Interior, upon the nomination of the Commissioner of Patents.

SEC. 477. The salaries of the officers mentioned in the preceding section shall be as follows :

The Commissioner of Patents, four thousand five hundred dollars a year.

The Assistant Commissioner of Patents, three thousand dollars a year.

Three examiners-in-chief, three thousand dollars a year each.

SEC. 478. The seal heretofore provided for the Patent Office shall be the seal of the Office, with which letters-patent and papers issued from the Office shall be authenticated.

SEC. 479. The Commissioner of Patents and the chief clerk, before entering upon their duties, shall severally give bond, with sureties, to the Treasurer of the United States, the former in the sum of ten thousand dollars, and the latter in the sum of five thousand dollars, conditioned for the faithful discharge of their respective duties, and that they shall render to the proper officers of the Treasury a true account of all money received by virtue of their offices.

SEC. 480. All officers and employes of the Patent Office shall be incapable, during the period for which they hold their appointments, to acquire or take, directly or indirectly, except by inheritance or bequest, any right or interest in any patent issued by the Office.

SEC. 481. The Commissioner of Patents, under the direc-

tion of the Secretary of the Interior, shall superintend or perform all duties respecting the granting and issuing of patents directed by law; and he shall have charge of all books, records, papers, models, machines, and other things belonging to the Patent Office.

SEC. 482. The examiners-in-chief shall be persons of competent legal knowledge and scientific ability, whose duty it shall be, on the written petition of the appellant, to revise and determine upon the validity of the adverse decisions of examiners upon applications for patents, and for reissues of patents, and in interference cases; and, when required by the Commissioner, they shall hear and report upon claims for extensions, and perform such other like duties as he may assign them.

SEC. 483. The Commissioner of Patents, subject to the approval of the Secretary of the Interior, may from time to time establish regulations, not inconsistent with law, for the conduct of proceedings in the Patent Office.

SEC. 484. The Commissioner of Patents shall cause to be classified and arranged in suitable cases, in the rooms and galleries provided for that purpose, models, specimens of composition, fabrics, manufactures, works of art, and designs, which have been or shall be deposited in the Patent Office; and the rooms and galleries shall be kept open during suitable hours for public inspection.

SEC. 485. The Commissioner of Patents may restore to the respective applicants such of the models belonging to rejected applications as he shall not think necessary to be preserved, or he may sell or otherwise dispose of them after the application has been finally rejected for one year, paying the proceeds into the Treasury, as other patent moneys are directed to be paid.

SEC. 486. There shall be purchased for the use of the Patent Office a library of such scientific works and periodicals, both foreign and American, as may aid the officers in the discharge of their duties, not exceeding the amount annually appropriated for that purpose.

SEC. 487. For gross misconduct the Commissioner of Patents may refuse to recognize any person as a patent agent, either generally or in any particular case; but the reasons for such refusal shall be duly recorded, and be subject to the approval of the Secretary of the Interior.

SEC. 488. The Commissioner of Patents may require all papers filed in the Patent Office, if not correctly, legibly, and clearly written, to be printed at the cost of the party filing them.

SEC. 489. The Commissioner of Patents may print, or

cause to be printed, copies of the claims of current issues, and copies of such laws, decisions, regulations, and circulars as may be necessary for the information of the public.

SEC. 490. The Commissioner of Patents is authorized to have printed, from time to time, for gratuitous distribution, not to exceed one hundred and fifty copies of the complete specifications and drawings of each patent hereafter issued, together with suitable indexes, one copy to be placed for free public inspection in each capitol of every State and Territory, one for the like purpose in the clerk's office of the district court of each judicial district of the United States, except when such offices are located in State or Territorial capitols, and one in the Library of Congress, which copies shall be certified under the hand of the Commissioner and seal of the Patent Office, and shall not be taken from the depositories for any other purpose than to be used as evidence.

SEC. 491. The Commissioner of Patents is authorized to have printed such additional numbers of copies of specifications and drawings, certified as provided in the preceding section, at a price not to exceed the contract price for such drawings, for sale, as may be warranted by the actual demand for the same; and he is also authorized to furnish a complete set of such specifications and drawings to any public library which will pay for binding the same into volumes to correspond with those in the Patent Office, and for the transportation of the same, and which shall also provide for proper custody for the same, with convenient access for the public thereto, under such regulations as the Commissioner shall deem reasonable.

SEC. 492. The lithographing and engraving required by the two preceding sections shall be awarded to the lowest and best bidders for the interest of the Government, due regard being paid to the execution of the work, after due advertising by the Congressional Printer under the direction of the Joint Committee on Printing; but the Joint Committee on Printing may empower the Congressional Printer to make immediate contracts for engraving, whenever, in their opinion, the exigencies of the public service will not justify waiting for advertisement and award; or if, in the judgment of the Joint Committee on Printing, the work can be performed under the direction of the Commissioner of Patents more advantageously than in the manner above prescribed, it shall be so done, under such limitations and conditions as the Joint Committee on Printing may from time to time prescribe.

SEC. 493. The price to be paid for uncertified printed

copies of specifications and drawings of patents shall be determined by the Commissioner of Patents, within the limits of ten cents as the minimum and fifty cents as the maximum price.

SEC. 494. The Commissioner of Patents shall lay before Congress, in the month of January, annually, a report, giving a detailed statement of all moneys received for patents, for copies of records or drawings, or from any other source whatever; a detailed statement of all expenditures for contingent and miscellaneous expenses; a list of all patents which were granted during the preceding year, designating under proper heads the subjects of such patents; an alphabetical list of all the patentees, with their places of residence; a list of all patents which have been extended during the year; and such other information of the condition of the Patent Office as may be useful to Congress or the public.

SEC. 495. The collections of the Exploring Expedition, now in the Patent Office, shall be under the care and management of the Commissioner of Patents.

SEC. 496. All disbursements for the Patent Office shall be made by the disbursing clerk of the Interior Department.

TITLE XIII., Rev. Stat., p. 168:

SEC. 571. [Refers to jurisdiction of certain district courts.]

SEC. 629. Clause 9. [The circuit courts have original jurisdiction] of all suits at law or in equity arising under the patent or copyright laws of the United States.

SEC. 892. Written or printed copies of any records, books, papers, or drawings belonging to the Patent Office, and of letters patent authenticated by the seal and certified by the Commissioner or Acting Commissioner thereof, shall be evidence in all cases wherein the originals could be evidence; and any person making application therefor, and paying the fee required by law, shall have certified copies thereof.

SEC. 893. Copies of the specifications and drawings of foreign letters-patent, certified as provided in the preceding section, shall be prima-facie evidence of the fact of the granting of such letters-patent, and of the date and contents thereof.

SEC. 894. The printed copies of specifications and drawings of patents, which the Commissioner of Patents is authorized to print for gratuitous distribution, and to deposit in the capitols of the States and Territories, and in the clerk's offices of the district courts, shall, when certified by him and authenticated by the seal of his office, be

received in all courts as evidence of all matters therein contained.

TITLE XV., Rev. Stat., p. 261.

SEC. 1537. No patented article connected with marine engines shall hereafter be purchased or used in connection with any steam vessels of war until the same shall have been submitted to a competent board of naval engineers, and recommended by such board, in writing, for purchase and use.

TITLE XVII., Rev. Stat., p. 292:

SEC. 1673. No royalty shall be paid by the United States to any one of its officers or employés for the use of any patent for the system, or any part thereof, mentioned in the preceding section, nor for any such patent in which said officers or employés may be directly or indirectly interested.

Concerning Applications for, and Issue of, Patents.

TITLE LX., Rev. Stat., chap. 1, p. 953:

SEC. 4883. All patents shall be issued in the name of the United States of America, under the seal of the Patent Office, and shall be signed by the Secretary of the Interior and countersigned by the Commissioner of Patents, and they shall be recorded, together with the specifications, in the Patent Office, in books to be kept for that purpose.

SEC. 4884. Every patent shall contain a short title or description of the invention or discovery, correctly indicating its nature and design, and a grant to the patentee, his heirs or assigns, for the term of seventeen years, of the exclusive right to make, use, and vend the invention or discovery throughout the United States, and the Territories thereof, referring to the specification for the particulars thereof. A copy of the specification and drawings shall be annexed to the patent and be a part thereof.

SEC. 4885. Every patent shall bear date as of a day not later than six months from the time at which it was passed and allowed and notice thereof was sent to the applicant or his agent; and if the final fee is not paid within that period, the patent shall be withheld.

SEC. 4886. Any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter, or any new and useful improvement thereof, not known nor used by others in this country, and not patented or described in any printed publication in this or any

foreign country, before his invention or discovery thereof, and not in public use or on sale for more than two years prior to his application, unless the same is proved to have been abandoned, may upon payment of the fees required by law, and other due proceedings had, obtain a patent therefor.

SEC. 4887. No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years.

SEC. 4888. Before any inventor or discoverer shall receive a patent for his invention or discovery, he shall make application therefor, in writing, to the Commissioner of Patents, and shall file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding, and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same; and in case of a machine, he shall explain the principle thereof, and the best mode in which he has contemplated applying that principle, so as to distinguish it from other inventions; and he shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery. The specification and claim shall be signed by the inventor and attested by two witnesses.

SEC. 4889. When the nature of the case admits of drawings, the applicant shall furnish one copy signed by the inventor or his attorney in fact, and attested by two witnesses, which shall be filed in the Patent Office; and a copy of the drawing, to be furnished by the Patent Office, shall be attached to the patent as a part of the specification.

SEC. 4890. When the invention or discovery is of a composition of matter, the applicant, if required by the Commissioner, shall furnish specimens of ingredients and of the composition, sufficient in quantity for the purpose of experimenting.

SEC. 4891. In all cases which admit of representation by

model, the applicant, if required by the Commissioner, shall furnish a model of convenient size to exhibit advantageously the several parts of his invention or discovery.

SEC. 4892. The applicant shall make oath that he does verily believe himself to be the original and first inventor or discoverer of the art, machine, manufacture, composition, or improvement for which he solicits a patent; that he does not know and does not believe that the same was ever before known or used; and shall state of what country he is a citizen. Such oath may be made before any person within the United States authorized by law to administer oaths, or when the applicant resides in a foreign country, before any minister, chargé d'affaires, consul, or commercial agent, holding commission under the Government of the United States, or before any notary public of the foreign country in which the applicant may be.

SEC. 4893. On the filing of any such application and the payment of the fees required by law, the Commissioner of Patents shall cause an examination to be made of the alleged new invention or discovery; and if on such examination it shall appear that the claimant is justly entitled to a patent under the law, and that the same is sufficiently useful and important, the Commissioner shall issue a patent therefor.

SEC. 4894. All applications for patents shall be completed and prepared for examination within two years after the filing of the application, and in default thereof, or upon failure of the applicant to prosecute the same within two years after any action therein, of which notice shall have been given to the applicant, they shall be regarded as abandoned by the parties thereto, unless it be shown to the satisfaction of the Commissioner of Patents that such delay was unavoidable.

Patents may be issued to Assignees.

SEC. 4895. Patents may be granted and issued or reissued to the assignee of the inventor or discoverer; but the assignment must first be entered of record in the Patent Office. And in all cases of an application by an assignee for the issue of a patent, the application shall be made and the specification sworn to by the inventor or discoverer; and in all cases of an application for a reissue of any patent, the application must be made and the corrected specification signed by the inventor or discoverer, if he is living, unless the patent was issued and the assignment made before the eighth day of July, eighteen hundred and seventy.

Patents to the Heirs of Deceased Inventors.

SEC. 4896. When any person, having made any new invention or discovery for which a patent might have been granted, dies before a patent is granted, the right of applying for and obtaining the patent shall devolve on his executor or administrator, in trust for the heirs at law of the deceased, in case he shall have died intestate; or if he shall have left a will, disposing of the same, then in trust for his devisees, in as full manner and on the same terms and conditions as the same might have been claimed or enjoyed by him in his lifetime; and when the application is made by such legal representatives, the oath or affirmation required to be made shall be so varied in form that it can be made by them.

Renewal of Lapsed Cases.

SEC. 4897. Any person who has an interest in an invention or discovery, whether as inventor, discoverer, or assignee, for which a patent was ordered to issue upon the payment of the final fee, but who fails to make payment thereof within six months from the time at which it was passed and allowed and notice thereof was sent to the applicant or his agent, shall have a right to make an application for a patent for such invention or discovery the same as in the case of an original application. But such second application must be made within two years after the allowance of the original application. But no person shall be held responsible in damages for the manufacture or use of any article or thing for which a patent was ordered to issue under such renewed application prior to the issue of the patent. And upon the hearing of renewed applications preferred under this section, abandonment shall be considered as a question of fact.

Assignment of Patents.

SEC. 4898. Every patent or any interest therein shall be assignable in law by an instrument in writing; and the patentee or his assigns or legal representatives may, in like manner, grant and convey an exclusive right under his patent to the whole or any specified part of the United States. An assignment, grant, or conveyance shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice, unless it is recorded in the Patent Office within three months from the date thereof.

Free Rights of Use.

SEC. 4899. Every person who purchases of the inventor, or discoverer, or with his knowledge and consent constructs any newly invented or discovered machine, or other patentable article, prior to the application by the inventor or discoverer for a patent, or who sells or uses one so constructed, shall have the right to use, and vend to others to be used, the specific thing so made or purchased, without liability therefor.

Patented Articles to be Stamped.

SEC. 4900. It shall be the duty of all patentees, and their assigns and legal representatives, and of all persons making or vending any patented article for or under them, to give sufficient notice to the public that the same is patented; either by affixing thereon the word "patented," together with the day and year the patent was granted; or when, from the character of the article, this can not be done, by fixing to it, or to the package wherein one or more of them is inclosed, a label containing the like notice; and in any suit for infringement, by the party failing so to mark, no damages shall be recovered by the plaintiff, except on proof that the defendant was duly notified of the infringement, and continued, after such notice, to make, use, or vend the article so patented.

Penalties for False Stamping.

SEC. 4901. Every person who, in any manner, marks upon any thing made, used, or sold by him for which he has not obtained a patent, the name or any imitation of the name of any person who has obtained a patent therefor, without the consent of such patentee, or his assigns or legal representatives; or

Who, in any manner, marks upon or affixes to any such patented article the word "patent" or "patentee," or the words "letters-patent," or any word of like import, with intent to imitate or counterfeit the mark or device of the patentee, without having the license or consent of such patentee or his assigns or legal representatives; or

Who, in any manner, marks upon or affixes to any unpatented article the word "patent" or any word importing that the same is patented, for the purpose of deceiving the public, shall be liable, for every such offence, to a penalty of not less than one hundred dollars, with costs; one half of said penalty to the person who shall sue for the same, and the other to the use of the United States, to be recovered by suit in any district court of the United States within whose jurisdiction such offence may have been committed.

Caveats.

SEC. 4902. Any citizen of the United States who makes any new invention or discovery, and desires further time to mature the same, may, on payment of the fees required by law, file in the Patent Office a caveat setting forth the design thereof, and of its distinguishing characteristics, and praying protection of his right until he shall have matured his invention. Such caveat shall be filed in the confidential archives of the office and preserved in secrecy, and shall be operative for the term of one year from the filing thereof; and if application is made within the year by any other person for a patent with which such caveat would in any manner interfere, the Commissioner shall deposit the description, specification, drawings, and model of such application in like manner in the confidential archives of the office, and give notice thereof, by mail, to the person by whom the caveat was filed. If such person desires to avail himself of his caveat, he shall file his description, specifications, drawings, and model within three months from the time of placing the notice in the post-office in Washington, with the usual time required for transmitting it to the caveator added thereto; which time shall be indorsed on the notice. An alien shall have the privilege herein granted, if he has resided in the United States one year next preceding the filing of his caveat, and has made oath of his intention to become a citizen.

Rejected Cases.

SEC. 4903. Whenever, on examination, any claim for a patent is rejected, the Commissioner shall notify the applicant thereof, giving him briefly the reasons for such rejection, together with such information and references as may be useful in judging of the propriety of renewing his application or of altering his specification; and if, after receiving such notice, the applicant persists in his claim for a patent, with or without altering his specifications, the Commissioner shall order a re-examination of the case.

Interferences.

SEC. 4904. Whenever an application is made for a patent which, in the opinion of the Commissioner, would interfere with any pending application, or with any unexpired patent, he shall give notice thereof to the applicants, or applicant and patentee, as the case may be, and shall direct the primary examiner to proceed to determine the question of priority of invention. And the Commissioner may issue a pat-

ent to the party who is adjudged the prior inventor, unless the adverse party appeals from the decision of the primary examiner, or of the board of examiners-in-chief, as the case may be, within such time, not less than twenty days, as the Commissioner shall prescribe.

Relating to Witnesses.

SEC. 4905. The Commissioner of Patents may establish rules for taking affidavits and depositions required in cases pending in the Patent Office, and such affidavits and depositions may be taken before any officer authorized by law to take depositions to be used in the courts of the United States, or of the State where the officer resides.

SEC. 4906. The clerk of any court of the United States, for any district or Territory wherein testimony is to be taken for use in any contested case pending in the Patent Office, shall, upon the application of any party thereto, or of his agent or attorney, issue a subpoena for any witness residing or being within such district or Territory, commanding him to appear and testify before any officer in such district or Territory authorized to take depositions and affidavits, at any time and place in the subpoena stated. But no witness shall be required to attend at any place more than forty miles from the place where the subpoena is served upon him.

SEC. 4907. Every witness duly subpoenaed and in attendance shall be allowed the same fees as are allowed to witnesses attending the courts of the United States.

SEC. 4908. Whenever any witness, after being duly served with such subpoena, neglects or refuses to appear, or after appearing refuses to testify, the judge of the court whose clerk issued the subpoena may, on proof of such neglect or refusal, enforce obedience to the process, or punish the disobedience as in other like cases. But no witness shall be guilty of contempt for disobeying such subpoena, unless his fees and travelling expenses in going to, returning from, and one day's attendance at the place of examination, are paid or tendered him at the time of the service of the subpoena; nor for refusing to disclose any secret invention or discovery made or owned by himself.

Appeals.

SEC. 4909. Every applicant for a patent or for the reissue for a patent, any of the claims of which have been twice rejected, and every party to an interference, may appeal from the decision of the primary examiner, or of the examiner in

charge of interferences in such case, to the board of examiners-in-chief; having once paid the fee for such appeal.

SEC. 4910. If such party is dissatisfied with the decision of the examiners-in-chief, he may, on payment of the fee prescribed, appeal to the Commissioner in person.

SEC. 4911. If such party, except a party to an interference, is dissatisfied with the decision of the Commissioner, he may appeal to the Supreme Court of the District of Columbia, sitting in banc.

SEC. 4912. When an appeal is taken to the Supreme Court of the District of Columbia, the appellant shall give notice thereof to the Commissioner, and file in the Patent Office, within such time as the Commissioner shall appoint, his reasons of appeal, specifically set forth in writing.

SEC. 4913. The court shall, before hearing such appeal, give notice to the Commissioner of the time and place of the hearing, and on receiving such notice the Commissioner shall give notice of such time and place in such manner as the court may prescribe, to all parties who appear to be interested therein. The party appealing shall lay before the court certified copies of all the original papers and evidence in the case, and the Commissioner shall furnish the court with the grounds of his decision, fully set forth in writing, touching all the points involved by the reasons of appeal. And at the request of any party interested, or of the court, the Commissioner and the examiners may be examined under oath, in explanation of the principles of the thing for which a patent is demanded.

SEC. 4914. The court, on petition, shall hear and determine such appeal, and revise the decision appealed from in a summary way, on the evidence produced before the Commissioner, at such early and convenient time as the court may appoint; and the revision shall be confined to the points set forth in the reasons of appeal. After hearing the case the court shall return to the Commissioner a certificate of its proceedings and decision, which shall be entered of record in the Patent Office, and shall govern the further proceedings in the case. But no opinion or decision of the court in any such case shall preclude any person interested from the right to contest the validity of such patent in any court wherein the same may be called in question.

SEC. 4915. Whenever a patent on application is refused, either by the Commissioner of Patents or by the Supreme Court of the District of Columbia upon appeal from the Commissioner, the applicant may have remedy by bill in equity; and the court having cognizance thereof, on notice to adverse parties and other due proceedings had, may ad-

judge that such applicant is entitled, according to law, to receive a patent for his invention, as specified in his claim, or for any part thereof, as the facts in the case may appear. And such adjudication, if it be in favor of the right of the applicant, shall authorize the Commissioner to issue such patent on the applicant filing in the Patent Office a copy of the adjudication, and otherwise complying with the requirements of law. In all cases, where there is no opposing party, a copy of the bill shall be served on the Commissioner; and all the expenses of the proceeding shall be paid by the applicant, whether the final decision is in his favor or not.

REISSUES.

SEC. 4916. Whenever any patent is inoperative or invalid, by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new, if the error has arisen by inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, the Commissioner shall, on the surrender of such patent and the payment of the duty required by law, cause a new patent for the same invention, and in accordance with the corrected specification, to be issued to the patentee, or, in the case of his death or of an assignment of the whole or any undivided part of the original patent, then to his executors, administrators, or assigns, for the unexpired part of the term of the original patent. Such surrender shall take effect upon the issue of the amended patent. The Commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the thing patented, upon demand of the applicant, and upon payment of the required fee for a reissue for each of such reissued letters-patent. The specifications and claim in every such case shall be subject to revision and restriction in the same manner as original applications are. Every patent so reissued, together with the corrected specification, shall have the same effect and operation in law, on the trial of all actions for causes thereafter arising, as if the same had been originally filed in such corrected form; but no new matter shall be introduced into the specification, nor in case of a machine patent shall the model or drawings be amended, except each by the other; but when there is neither model nor drawing, amendments may be made upon proof satisfactory to the Commissioner that such new matter or amendment was a part of the original invention, and was omitted from the specification by inadvertence, accident, or mistake, as aforesaid.

DISCLAIMERS.

SEC. 4917. Whenever, through inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, a patentee has claimed more than that of which he was the original or first inventor or discoverer, his patent shall be valid for all that part which is truly and justly his own, provided the same is a material or substantial part of the thing patented; and any such patentee, his heirs or assigns, whether of the whole or any sectional interest therein, may, on payment of the fee required by law, make disclaimer of such parts of the thing patented as he shall not choose to claim or to hold by virtue of the patent or assignment, stating therein the extent of his interest in such patent. Such disclaimer shall be in writing, attested by one or more witnesses, and recorded in the Patent Office; and it shall thereafter be considered as part of the original specification to the extent of the interest possessed by the claimant and by those claiming under him after the record thereof. But no such disclaimer shall affect any action pending at the time of its being filed, except so far as may relate to the question of unreasonable neglect or delay in filing it.

INTERFERING PATENTS.

SEC. 4918. Whenever there are interfering patents, any person interested in any one of them, or in the working of the invention claimed under either of them, may have relief against the interfering patentee, and all parties interested under him, by suit in equity against the owners of the interfering patent; and the court, on notice to adverse parties, and other due proceedings had according to the course of equity, may adjudge and declare either of the patents void in whole or in part, or inoperative, or invalid in any particular part of the United States, according to the interest of the parties in the patent or the invention patented. But no such judgment or adjudication shall affect the right of any person except the parties to the suit and those deriving title under them subsequent to the rendition of such judgment.

INFRINGEMENTS.

SEC. 4919. Damages for the infringement of any patent may be recovered by action on the case, in the name of the party interested, either as patentee, assignee, or grantee. And whenever in any such action a verdict is rendered for the plaintiff, the court may enter judgment thereon for any sum above the amount found by the verdict as the actual

damages sustained, according to the circumstances of the case, not exceeding three times the amount of such verdict, together with the costs.

SEC. 4920. In any action for infringement the defendant may plead the general issue, and having given notice in writing to the plaintiff or his attorney, thirty days before, may prove, on trial, any one or more of the following special matters:

First. That for the purpose of deceiving the public the description and specification filed by the patentee in the Patent Office was made to contain less than the whole truth relative to his invention or discovery, or more than is necessary to produce the desired effect; or,

Second. That he had surreptitiously or unjustly obtained the patent for that which was in fact invented by another, who was using reasonable diligence in adapting and perfecting the same; or,

Third. That it had been patented or described in some printed publication prior to his supposed invention or discovery thereof; or,

Fourth. That he was not the original and first inventor or discoverer of any material and substantial part of the thing patented; or,

Fifth. That it had been in public use or on sale in this country for more than two years before his application for a patent, or had been abandoned to the public.

And in notices as to proof of previous invention, knowledge, or use of the thing patented, the defendant shall state the names of patentees and the dates of their patents, and when granted, and the names and residences of the persons alleged to have invented, or to have had the prior knowledge of the thing patented, and where and by whom it had been used; and if any one or more of the special matters alleged shall be found for the defendant, judgment shall be rendered for him with costs. And the like defences may be pleaded in any suit in equity for relief against an alleged infringement; and proofs of the same may be given upon like notice in the answer of the defendant, and with the like effect.

SEC. 4921. The several courts vested with jurisdiction of cases arising under the patent laws shall have power to grant injunctions according to the course and principles of courts of equity, to prevent the violation of any right secured by patent, on such terms as the court may deem reasonable; and upon a decree being rendered in any such case for an infringement, the complainant shall be entitled to recover, in addition to the profits to be accounted for by

the defendant, the damages the complainant has sustained thereby; and the court shall assess the same or cause the same to be assessed under its direction. And the court shall have the same power to increase such damages, in its discretion, as is given to increase the damages found by verdicts in actions in the nature of actions of trespass upon the case.

SEC. 4922. Whenever, through inadvertence, accident, or mistake, and without any wilful default or intent to defraud or mislead the public, a patentee has, in his specification, claimed to be the original and first inventor or discoverer of any material or substantial part of the thing patented, of which he was not the original and first inventor or discoverer, every such patentee, his executors, administrators, and assigns, whether of the whole or any sectional interest in the patent, may maintain a suit at law or in equity, for the infringement of any part thereof, which was *bona fide* his own, if it is a material and substantial part of the thing patented, and definitely distinguishable from the parts claimed without right, notwithstanding the specifications may embrace more than that of which the patentee was the first inventor or discoverer. But in every such case in which a judgment or decree shall be rendered for the plaintiff no costs shall be recovered unless the proper disclaimer has been entered at the Patent Office before the commencement of the suit. But no patentee shall be entitled to the benefits of this section if he has unreasonably neglected or delayed to enter a disclaimer.

SEC. 4923. Whenever it appears that a patentee, at the time of making his application for the patent, believed himself to be the original and first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery, or any part thereof, having been known or used in a foreign country, before his invention or discovery thereof, if it had not been patented or described in a printed publication.

SEC. 4928. The benefit of the extension of a patent shall extend to the assignees and grantees of the right to use the thing patented, to the extent of their interest therein.

PATENTS FOR DESIGNS.

SEC. 4929. Any person who, by his own industry, genius, efforts, and expense, has invented and produced any new and original design for a manufacture, bust, statue, alto-relievo, or bas-relief; any new and original design for the printing of woollen, silk, cotton, or other fabrics; any new and original impression, ornament, patent, [pattern,] print, or picture to be

printed, painted, cast, or otherwise placed on or worked into any article of manufacture; or any new, useful, and original shape or configuration of any article of manufacture, the same not having been known or used by others before his invention or production thereof, or patented or described in any printed publication, may, upon payment of the fee prescribed, and other due proceedings had the same as in cases of inventions or discoveries, obtain a patent therefor.

SEC. 4930. The Commissioner may dispense with models of designs when the design can be sufficiently represented by drawings or photographs.

SEC. 4931. Patents for designs may be granted for the term of three years and six months, or for seven years, or for fourteen years, as the applicant may, in his application, elect.

SEC. 4932. Patentees of designs issued prior to the second day of March, eighteen hundred and sixty-one, shall be entitled to extension of their respective patents for the term of seven years, in the same manner and under the same restrictions as are provided for the extension of patents for inventions or discoveries, issued prior to the second day of March, eighteen hundred and sixty-one.

SEC. 4933. All the regulations and provisions which apply to obtaining or protecting patents for inventions or discoveries not inconsistent with the provisions of this title, shall apply to patents for designs.

OFFICIAL FEES.

SEC. 4934. The following shall be the rates for patent fees:

On filing each original application for a patent, except in design cases, fifteen dollars.

On issuing each original patent, except in design cases, twenty dollars.

In design cases: For three years and six months, ten dollars; for seven years, fifteen dollars; for fourteen years, thirty dollars.

On filing each caveat, ten dollars.

On every application for the reissue of a patent thirty dollars.

On filing each disclaimer, ten dollars.

On every application for the extension of a patent, fifty dollars.

On the granting of every extension of a patent, fifty dollars.

On an appeal for the first time from the primary examiners to the examiners-in-chief, ten dollars.

On every appeal from the examiners-in-chief to the Commissioner, twenty dollars.

For certified copies of patents and other papers, including certified printed copies, ten cents per hundred words.

For recording every assignment, agreement, power of attorney, or other paper, of three hundred words or under, one dollar; of over three hundred and under one thousand words, two dollars; of over one thousand words, three dollars.

For copies of drawings, the reasonable cost of making them.

SEC. 4935. Patent fees may be paid to the Commissioner of Patents, or to the Treasurer or any of the assistant treasurers of the United States, or to any of the designated depositories, national banks, or receivers of public money, designated by the Secretary of the Treasury for that purpose; and such officer shall give the depositor a receipt or certificate of deposit therefor. All money received at the Patent Office, for any purpose, or from any source whatever, shall be paid into the Treasury as received, without any deduction whatever.

SEC. 4936. The Treasurer of the United States is authorized to pay back any sum or sums of money to any person who has through mistake paid the same into the Treasury, or to any receiver or depository, to the credit of the Treasury, as for fees accruing at the Patent Office, upon a certificate thereof being made to the Treasurer by the Commissioner of Patents.

REGISTRATION OF TRADE-MARKS.

TITLE LX., Rev. Stat., Chap. 2, p. 963.

SEC. 4937. Any person or firm domiciled in the United States, and any corporation created by the authority of the United States, or of any State or Territory thereof, and any person, firm, or corporation resident of or located in any foreign country which by treaty or convention affords similar privileges to citizens of the United States, and who are entitled to the exclusive use of any lawful trade-mark, or who intend to adopt and use any trade-mark for exclusive use within the United States, may obtain protection for such lawful trade-mark by complying with the following requirements:

First. By causing to be recorded in the Patent Office a statement specifying the names of the parties, and their residences and place of business, who desire the protection of the trade-mark; the class of merchandise, and the particular description of goods comprised in such class, by which the trade-mark has been or is intended to be appropriated; a description of the trade-mark itself, with *fac-similes* thereof,

showing the mode in which it has been or is intended to be applied and used; and the length of time, if any, during which the trade-mark has been in use.

Second. By making payment of a fee of twenty-five dollars in the same manner and for the same purpose as the fee required for patents.

Third. By complying with such regulations as may be prescribed by the Commissioner of Patents.

SEC. 4938. The certificate prescribed by the preceding section must, in order to create any right whatever in favor of the party filing it, be accompanied by a written declaration verified by the person, or by some member of the firm or officer of the corporation by whom it is filed, to the effect that the party claiming protection for the trade-mark has a right to the use of the same, and that no other person, firm, or corporation has the right to such use, either in the identical form or in any such near resemblance thereto as might be calculated to deceive; and that the description and *fac-similes* presented for record are true copies of the trade-mark sought to be protected.

SEC. 4939. The Commissioner of Patents shall not receive and record any proposed trade-mark which is not and can not become a lawful trade-mark, or which is merely the name of a person, firm, or corporation unaccompanied by a mark sufficient to distinguish it from the same name when used by other persons, or which is identical with a trade-mark appropriate to the same class of merchandise, and belonging to a different owner, and already registered or received for registration, or which so nearly resembles such last-mentioned trade-mark as to be likely to deceive the public. But this section shall not prevent the registry of any lawful trade-mark rightfully in use on the eighth day of July, eighteen hundred and seventy.

SEC. 4940. The time of the receipt of any trade-mark at the Patent Office for registration shall be noted and recorded. Copies of the trade-mark and of the date of the receipt thereof, and of the statement filed therewith, under the seal of the Patent Office, certified by the Commissioner, shall be evidence in any suit in which such trade-mark shall be brought in controversy.

SEC. 4941. A trade-mark registered as above prescribed shall remain in force for thirty years from the date of such registration; except in cases where such trade-mark is claimed for and applied to articles not manufactured in this country and in which it receives protection under the laws of any foreign country for a shorter period, in which case it shall cease to have any force in this country by virtue of this act.

at the same time that it becomes of no effect elsewhere. Such trade-mark during the period that it remains in force shall entitle the person, firm or corporation registering the same to the exclusive use thereof so far as regards the description of goods to which it is appropriated in the statement filed under oath as aforesaid, and no other person shall lawfully use the same trade-mark, or substantially the same, or so nearly resembling it as to be calculated to deceive, upon substantially the same description of goods. And at any time during the six months prior to the expiration of the term of thirty years, application may be made for a renewal of such registration, under regulations to be prescribed by the Commissioner of Patents. The fee for such renewal shall be the same as for the original registration; and a certificate of such renewal shall be issued in the same manner as for the original registration; and such trade-mark shall remain in force for a further term of thirty years.

SEC. 4942. Any person who shall reproduce, counterfeit, copy, or imitate any recorded trade-mark and affix the same to goods of substantially the same descriptive properties and qualities as those referred to in the registration, shall be liable to an action on the case for damages for such wrongful use of such trade-mark, at the suit of the owner thereof; and the party aggrieved shall also have his remedy according to the course of equity to enjoin the wrongful use of his trade-mark and to recover compensation therefor in any court having jurisdiction over the person guilty of such wrongful use.

SEC. 4943. No action shall be maintained under the provisions of this chapter by any person claiming the exclusive right to any trade-mark which is used or claimed in any unlawful business, or upon any article which is injurious in itself, or upon any trade-mark which has been fraudulently obtained, or which has been formed and used with the design of deceiving the public in the purchase or use of any article of merchandise.

SEC. 4944. Any person who shall procure the registry of any trade-mark, or of himself as the owner of a trade-mark, or an entry respecting a trade-mark in the Patent Office, by making any false or fraudulent representations or declarations, verbally or in writing, or by any fraudulent means, shall be liable to pay any damages sustained in consequence of any such registry or entry, to the person injured thereby; to be recovered in an action on the case.

SEC. 4945. Nothing in this chapter shall prevent, lessen, impeach, or avoid any remedy at law or in equity, which any party aggrieved by any wrongful use of any trade-mark

might have had if the provisions of this chapter had not been enacted.

SEC. 4946. Nothing in this chapter shall be construed by any court as abridging or in any matter affecting unfavorably the claim of any person to any trade-mark after the expiration of the term for which such trade-mark was registered.

SEC. 4947. The Commissioner of Patents is authorized to make rules, regulations, and prescribe forms for the transfer of the right to the use of trade-marks, conforming as nearly as practicable to the requirements of law respecting the transfer and transmission of copyrights.

AN ACT

TO PUNISH THE COUNTERFEITING OF TRADE-MARK GOODS
AND THE SALE OR DEALING IN OF COUNTERFEIT TRADE-
MARK GOODS.

Approved August 14th, 1876.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That every person who shall with intent to defraud, deal in or sell, or keep or offer for sale, or cause or procure the sale of, any goods of substantially the same descriptive properties as those referred to in the registration of any trade-mark, pursuant to the statutes of the United States, to which, or to the package in which the same are put up, is fraudulently affixed said trade-mark, or any colorable imitation thereof, calculated to deceive the public, knowing the same to be counterfeit or not the genuine goods referred to in said registration, shall, on conviction thereof, be punished by fine not exceeding one thousand dollars, or imprisonment not more than two years, or both such fine and imprisonment.

SEC. 2. That every person who fraudulently affixes, or causes or procures to be fraudulently affixed, any trade-mark registered pursuant to the statutes of the United States, or any colorable imitation thereof, calculated to deceive the public, to any goods, of substantially the same descriptive properties as those referred to in said registration, or to the package in which they are put up, knowing the same to be counterfeit, or not the genuine goods, referred to in said re-

gistration, shall on conviction thereof, be punished as prescribed in the first section of this act.

SEC. 3. That every person who fraudulently fills, or causes or procures to be fraudulently filled, any package to which is affixed any trade-mark, registered pursuant to the statutes of the United States, or any colorable imitation thereof, calculated to deceive the public, with any goods of substantially the same descriptive properties as those referred to in said registration, knowing the same to be counterfeit, or not the genuine goods referred to in said registration, shall, on conviction thereof, be punished as prescribed in the first section of this act.

SEC. 4. That any person or persons who shall, with intent to defraud any person or persons, knowingly and wilfully cast, engrave, or manufacture, or have in his, her, or their possession, or buy, sell, offer for sale, or deal in, any die or dies, plate or plates, brand or brands, engraving or engravings, on wood, stone, metal, or other substance, moulds, or any false representation, likeness, copy, or colorable imitation of any die, plate, brand, engraving, or mould of any private label, brand, stamp, wrapper, engraving on paper or other substance, or trade-mark, registered pursuant to the statutes of the United States, shall, upon conviction thereof, be punished as prescribed in the first section of this act.

SEC. 5. That any person or persons who shall, with intent to defraud any person or persons, knowingly and wilfully make, forge, or counterfeit, or have in his, her, or their possession, or buy, sell, offer for sale, or deal in, any representation, likeness, similitude, copy, or colorable imitation of any private label, brand, stamp, wrapper, engraving, mould, or trade-mark, registered pursuant to the statutes of the United States, shall, upon conviction thereof, be punished as prescribed in the first section of this act.

SEC. 6. That any person who shall, with intent to injure or defraud the owner of any trade-mark, or any other person lawfully entitled to use or protect the same, buy, sell, offer for sale, deal in or have in his possession any used or empty box, envelope, wrapper, case, bottle, or other package, to which is affixed, so that the same may be obliterated without substantial injury to such box or other thing aforesaid, any trade-mark, registered pursuant to the statutes of the United States, not so defaced, erased, obliterated, and destroyed as to prevent its fraudulent use, shall, on conviction thereof, be punished as prescribed in the first section of this act.

SEC. 7. That if the owner of any trade-mark, registered pursuant to the statutes of the United States, or his agent, make oath, in writing, that he has reason to believe, and

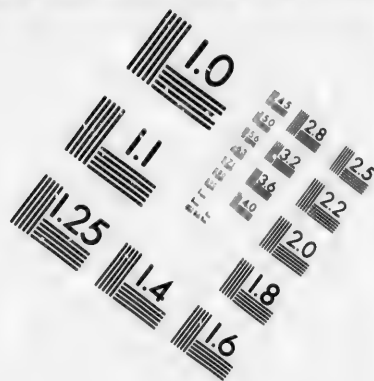
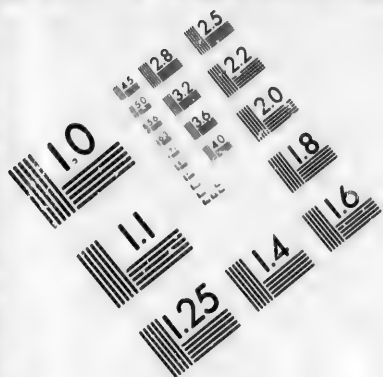
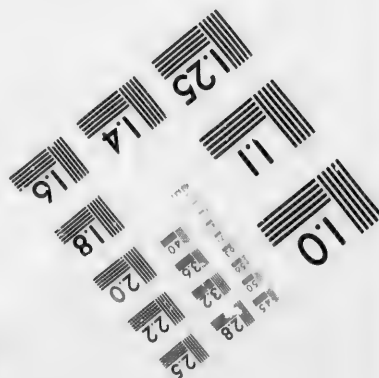
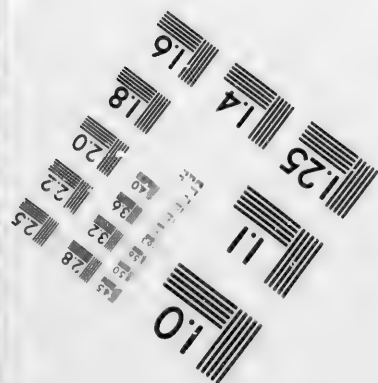
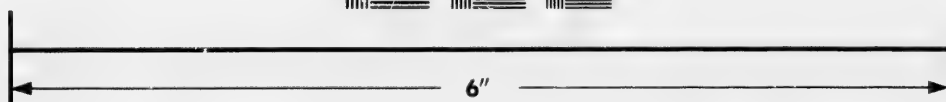
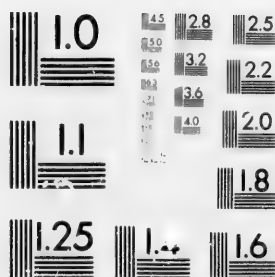


IMAGE EVALUATION TEST TARGET (MT-3)



Photographic Sciences Corporation

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WEBSTER, N.Y. 14580
(716) 872-4503**

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does believe, that any counterfeit dies, plates, brands, engravings on wood, stone, metal, or other substance, or moulds, of his said registered trade-mark, are in the possession of any person, with intent to use the same for the purpose of deception and fraud, or makes such oaths that any counterfeits or colorable imitations of his said trade-mark, label, brand, stamp, wrapper, engraving on paper or other substance, or empty box, envelope, wrapper, case, bottle or other package, to which is affixed said registered trade-mark not so defaced, erased, obliterated, and destroyed as to prevent its fraudulent use, are in the possession of any person, with intent to use the same for the purpose of deception and fraud, then the several judges of the circuit and district courts of the United States and the Commissioners of the circuit courts may, within their respective jurisdictions, proceed under the law relating to search-warrants, and may issue a search-warrant authorizing and directing the marshal of the United States for the proper district to search for and seize all said counterfeit dies, plates, brands, engravings on wood, stone, metal, or other substance, moulds, and said counterfeit trade-marks, colorable imitations thereof, labels, brands, stamps, wrappers, engravings on paper, or other substance, and said empty boxes, envelopes, wrappers, cases, bottles, or other packages that can be found; and upon satisfactory proof being made that said counterfeit dies, plates, brands, engravings on wood, stone, metal, or other substance, moulds, counterfeit trade-marks, colorable imitations thereof, labels, brands, stamps, wrappers, engravings on paper or other substance, empty boxes, envelopes, wrappers, cases, bottles, or other packages, are to be used by the holder or owner for the purposes of deception and fraud, that any of said judges shall have full power to order all said counterfeit dies, plates, brands, engravings on wood, stone, metal, or other substance, moulds, counterfeit trade-marks, colorable imitations thereof, labels, brands, stamps, wrappers, engravings on paper or other substance, empty boxes, envelopes, wrappers, cases, bottles, or other packages, to be publicly destroyed.

SEC. 8. That any person who shall, with intent to defraud any person or persons, knowingly and wilfully aid or abet in the violation of any of the provisions of this act, shall, upon conviction thereof, be punished by a fine not exceeding five hundred dollars, or imprisonment not more than one year, or both such fine and imprisonment.

THE
COPYRIGHT LAWS
OF THE
UNITED STATES.

IN FORCE AUGUST 1, 1874.

FROM THE REVISED STATUTES OF THE
UNITED STATES, IN FORCE DECEMBER 1, 1873, AS AMENDED BY ACT
APPROVED JUNE 18, 1874.

SEC. 4948. All records and other things relating to copyrights and required by law to be preserved, shall be under the control of the Librarian of Congress, and kept and preserved in the Library of Congress; and the Librarian of Congress shall have the immediate care and supervision thereof, and, under the supervision of the Joint Committee of Congress on the Library, shall perform all acts and duties required by law touching copyrights.

SEC. 4949. The seal provided for the office of the Librarian of Congress shall be the seal thereof, and by it all records and papers issued from the office, and to be used in evidence, shall be authenticated.

SEC. 4950. The Librarian of Congress shall give a bond, with sureties, to the Treasurer of the United States, in the sum of five thousand dollars, with the condition that he will render to the proper officers of the Treasury a true account of all moneys received by virtue of his office.

SEC. 4951. The Librarian of Congress shall make an annual report to Congress of the number and description of copyright publications for which entries have been made during the year.

SEC. 4952. Any citizen of the United States, or resident therein, who shall be the author, inventor, designer, or proprietor of any book, map, chart, dramatic or musical compo-

sition, engraving, cut, print, photograph or negative thereof, or of a painting, drawing, chromo, statue, statuary, and of models or designs intended to be perfected as works of the fine arts, and the executors, administrators, or assigns of any such person, shall, upon complying with the provisions of this chapter, have the sole liberty of printing, reprinting, publishing, completing, copying, executing, finishing, and vending the same; and, in the case of a dramatic composition, of publicly performing or representing it, or causing it to be performed or represented by others. And authors may reserve the right to dramatize or translate their own works.

SEC. 4953. Copyrights shall be granted for the term of twenty-eight years from the time of recording the title thereof, in the manner hereinafter directed.

SEC. 4954. The author, inventor, or designer, if he be still living and a citizen of the United States or resident therein, or his widow or children if he be dead, shall have the same exclusive right continued for the further term of fourteen years, upon recording the title of the work or description of the article so secured a second time, and complying with all other regulations in regard to original copyrights, within six months before the expiration of the first term. And such person shall, within two months from the date of said renewal, cause a copy of the record thereof to be published in one or more newspapers, printed in the United States, for the space of four weeks.

SEC. 4955. Copyrights shall be assignable in law by any instrument of writing, and such assignment shall be recorded in the office of the Librarian of Congress within sixty days after its execution; in default of which it shall be void as against any subsequent purchaser or mortgagee for a valuable consideration, without notice.

SEC. 4956. No person shall be entitled to a copyright unless he shall, before publication, deliver at the office of the Librarian of Congress, or deposit in the mail addressed to the Librarian of Congress, at Washington, District of Columbia, a printed copy of the title of the book or other article, or a description of the painting, drawing, chromo, statue, statuary, or model or design for a work of the fine arts, for which he desires a copyright; nor unless he shall also, within ten days from the publication thereof, deliver at the office of the Librarian of Congress, or deposit in the mail addressed to the Librarian of Congress, at Washington, District of Columbia, two copies of such copyright book or other article, or, in case of a painting, drawing, statue, statuary, model or design for a work of the fine arts, a photograph of the same.

SEC. 4957. The Librarian of Congress shall record the name of such copyright book, or other article, forthwith in a book to be kept for that purpose, in the words following: "Library of Congress, to wit: Be it remembered that on the — day of —, —, A. B., of —, hath deposited in this office the title of a book (map, chart, or otherwise, as the case may be, or description of the article), the title or description of which is in the following words, to wit: (here insert the title or description,) the right whereof he claims as author, (originator, or proprietor, as the case may be,) in conformity with the laws of the United States respecting copyrights. C. D., Librarian of Congress." And he shall give a copy of the title or description, under the seal of the Librarian of Congress, to the proprietor whenever he shall require it.

SEC. 4958. The Librarian of Congress shall receive from the persons to whom the services designated are rendered, the following fees: 1. For recording the title or description of any copyright book or other article, fifty cents. 2. For every copy under seal of such record actually given to the person claiming the copyright, or his assigns, fifty cents. 3. For recording and certifying any instrument of writing for the assignment of a copyright, one dollar. 4. For every copy of an assignment, one dollar. All fees so received shall be paid into the Treasury of the United States.

SEC. 4959. The proprietor of every copyright book or other article shall deliver at the office of the Librarian of Congress, or deposit in the mail addressed to the Librarian of Congress, at Washington, District of Columbia, within ten days after its publication, two complete printed copies thereof, of the best edition issued, or description or photograph of such article as hereinbefore required, and a copy of every subsequent edition wherein any substantial changes shall be made.

SEC. 4960. For every failure on the part of the proprietor of any copyright to deliver, or deposit in the mail, either of the published copies, or description, or photograph, required by Sections 4956 and 4959, the proprietor of the copyright shall be liable to a penalty of twenty-five dollars, to be recovered by the Librarian of Congress, in the name of the United States, in an action in the nature of an action of debt, in any district court of the United States within the jurisdiction of which the delinquent may reside or be found.

SEC. 4961. The postmaster to whom such copyright book, title, or other article, is delivered, shall, if requested, give a receipt therefor; and when so delivered he shall mail it to its destination.

SEC. 4962. No person shall maintain an action for the in-

fringement of his copyright unless he shall give notice thereof by inserting in the several copies of every edition published, on the title-page or the page immediately following, if it be a book; or if a map, chart, musical composition, print, cut, engraving, photograph, painting, drawing, chromo, statue, statuary, or model or design intended to be perfected and completed as a work of the fine arts, by inscribing upon some visible portion thereof, or of the substance on which the same shall be mounted, the following words, viz.: "Entered according to act of Congress, in the year ———, by A. B., in the office of the Librarian of Congress at Washington;" or, at his option, the word "Copyright," together with the year the copyright was entered, and the name of the party by whom it was taken out, thus: "Copyright, 18—, by A. B."

SEC. 4963. Every person who shall insert or impress such notice, or words of the same purport, in or upon any book, map, chart, musical composition, print, cut, engraving, or photograph, or other article, for which he has not obtained a copyright, shall be liable to a penalty of one hundred dollars, recoverable one half for the person who shall sue for such penalty, and one half to the use of the United States.

SEC. 4964. Every person who, after the recording of the title of any book as provided by this chapter, shall, within the term limited, and without the consent of the proprietor of the copyright first obtained in writing, signed in presence of two or more witnesses, print, publish, or import, or, knowing the same to be so printed, published, or imported, shall sell or expose to sale any copy of such book, shall forfeit every copy thereof to such proprietor, and shall also forfeit and pay such damages as may be recovered in a civil action by such proprietor in any court of competent jurisdiction.

SEC. 4965. If any person, after the recording of the title of any map, chart, musical composition, print, cut, engraving, photograph, or chromo, or of the description of any painting, drawing, statue, statuary, or model or design intended to be perfected and executed as a work of the fine arts, as provided by this chapter, shall, within the time limited, and without the consent of the proprietor of the copyright first obtained in writing, signed in presence of two or more witnesses, engrave, etch, work, copy, print, publish, or import, either in whole or in part, or by varying the main design with intent to evade the law, or, knowing the same to be so printed, published, or imported, shall sell or expose to sale any copy of such map or other article, as aforesaid, he shall forfeit to the proprietor all the plates on which the same shall be copied, and every sheet thereof, either copied or printed, and shall further forfeit one dollar for every sheet of the same found in his pos-

session, either printing, printed, copied, published, imported, or exposed for sale; and in case of a painting, statue, or statutory, he shall forfeit ten dollars for every copy of the same in his possession, or by him sold or exposed for sale; one half thereof to the proprietor, and the other half to the use of the United States.

SEC. 4966. Any person publicly performing or representing any dramatic composition for which a copyright has been obtained, without the consent of the proprietor thereof, or his heirs or assigns, shall be liable for damages therefor; such damages in all cases to be assessed at such sum, not less than one hundred dollars for the first, and fifty dollars for every subsequent performance, as to the court shall appear to be just.

SEC. 4967. Every person who shall print or publish any manuscript whatever, without the consent of the author or proprietor first obtained, (if such author or proprietor is a citizen of the United States, or resident therein,) shall be liable to the author or proprietor for all damages occasioned by such injury.

SEC. 4968. No action shall be maintained in any case of forfeiture or penalty under the copyright laws, unless the same is commenced within two years after the cause of action has arisen.

SEC. 4969. In all actions arising under the laws respecting copyrights the defendant may plead the general issue, and give the special matter in evidence.

SEC. 4970. The circuit courts, and district courts having the jurisdiction of circuit courts, shall have power, upon bill in equity, filed by any party aggrieved, to grant injunctions to prevent the violation of any right secured by the laws respecting copyrights, according to the course and principles of courts of equity, on such terms as the court may deem reasonable.

SEC. 4971. Nothing in this chapter shall be construed to prohibit the printing, publishing, importation, or sale of any book, map, chart, dramatic or musical composition, print, cut, engraving, or photograph, written, composed, or made by any person not a citizen of the United States nor resident therein.

Amendments approved June 18, 1874.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress Assembled, That no person shall maintain an action for the infringement of his copyright unless he shall give notice thereof by inserting in

the several copies of every edition published, on the title-page or the page immediately following, if it be a book; or if a map, chart, musical composition, print, cut, engraving, photograph, painting, drawing, chromo, statue, statuary, or model or design intended to be perfected and completed as a work of the fine arts, by inscribing upon some visible portion thereof, or of the substance on which the same shall be mounted, the following words, viz.: "Entered according to act of Congress, in the year —, by A. B., in the office of the Librarian of Congress, at Washington;" or, at his option, the word "Copyright," together with the year the copyright was entered, and the name of the party by whom it was taken out; thus—"Copyright, 18—, by A. B."

SEC. 2. That for recording and certifying any instrument of writing for the assignment of a copyright, the Librarian of Congress shall receive from the persons to whom the service is rendered, one dollar; and for every copy of an assignment, one dollar; said fee to cover, in either case, a certificate of the record, under seal of the Librarian of Congress; and all fees so received shall be paid into the Treasury of the United States.

COPYRIGHTS FOR LABELS.

SEC. 3. That in the construction of this act, the words "engraving," "cut," and "print" shall be applied only to pictorial illustrations or works connected with the fine arts, and no prints or labels designed to be used for any other articles of manufacture shall be entered under the copyright law, but may be registered in the Patent Office. And the Commissioner of Patents is hereby charged with the supervision and control of the entry or registry of such prints or labels, in conformity with the regulations provided by law as to copyright of prints, except that there shall be paid for recording the title of any print or label not a trade-mark, six dollars, which shall cover the expense of furnishing a copy of the record under the seal of the Commissioner of Patents, to the party entering the same.

SEC. 4. That all laws and parts of laws inconsistent with the foregoing provisions be and the same are hereby repealed.

SEC. 5. That this act shall take effect on and after the first day of August, eighteen hundred and seventy-four.

Repeal Provisions.

TITLE LXXIV., Rev. Stat., p. 1091:

SEC. 5595. The foregoing seventy-three titles embrace the

statutes of the United States general and permanent in their nature, in force on the 1st day of December, one thousand eight hundred and seventy-three, as revised and consolidated by commissioners appointed under an act of Congress, and the same shall be designated and cited, as The Revised Statutes of the United States.

SEC. 5596. All acts of Congress passed prior to said first day of December, one thousand eight hundred and seventy-three, any portion of which is embraced in any section of said revision, are hereby repealed, and the section applicable thereto shall be in force in lieu thereof; all parts of such acts not contained in such revision, having been repealed or superseded by subsequent acts, or not being general and permanent in their nature: *Provided*, That the incorporation into said revision of any general and permanent provision, taken from an act making appropriations, or from an act containing other provisions of a private, local, or temporary character, shall not repeal, or in any way affect any appropriation, or any provision of a private, local, or temporary character, contained in any of said acts, but the same shall remain in force; and all acts of Congress passed prior to said last-named day, no part of which are embraced in said revision, shall not be affected or changed by its enactment.

SEC. 5597. The repeal of the several acts embraced in said revision shall not affect any act done, or any right accruing or accrued, or any suit or proceeding had or commenced in any civil cause before the said repeal, but all rights and liabilities under said acts shall continue, and may be enforced in the same manner, as if said repeal had not been made; nor shall said repeal in any manner affect the right to any office, or change the term or tenure thereof.

SEC. 5598. All offences committed, and all penalties or forfeitures incurred under any statute embraced in said revision prior to said repeal, may be prosecuted and punished in the same manner and with the same effect as if said repeal had not been made.

SEC. 5599. All acts of limitation, whether applicable to civil causes and proceedings, or to the prosecution of offences, or for the recovery of penalties or forfeitures, embraced in said revision and covered by said repeal, shall not be affected thereby, but all suits, proceedings, or prosecutions, whether civil or criminal, for causes arising or acts done or committed prior to said repeal, may be commenced and prosecuted within the same time as if said repeal had not been made.

SEC. 5600. The arrangement and classification of the several sections of the revision have been made for the purpose of a more convenient and orderly arrangement of the same, and therefore no inference or presumption of a legislative construction is to be drawn by reason of the Title under which any particular section is placed.

SEC. 5601. The enactment of the said revision is not to affect or repeal any act of Congress passed since the 1st day of December, one thousand eight hundred and seventy-three, and all acts passed since that date are to have full effect as if passed after the enactment of this revision, and so far as such acts vary from, or conflict with, any provision contained in said revision, they are to have effect as subsequent statutes, and as repealing any portion of the revision inconsistent therewith.

EFFECTS OF HEAT UPON BODIES.

	Fahrenheit. Deg.		Fahrenheit. Deg.
Cast-iron melts.....	2786	Cadmium.....	450
Gold ".....	2016	Tin melts.....	442
Copper ".....	1996	Tin and bismuth, equal	
Brass ".....	1900	parts, melts.....	283
Silver ".....	1873	Tin 3 parts, bismuth 5 parts,	
Red heat visible by day..	1077	lead 2 parts, melt.....	212
Iron red-hot in twilight..	884	Sodium.....	190
Common fire.....	790	Alcohol boils.....	174
Zinc melts.....	773	Potassium.....	136
Iron, bright red in dark...	752	Ether boils.....	98
Mercury boils.....	630	Human blood (heat of)....	98
Lead melts.....	612	Strong wines freeze.....	20
Linseed oil boils.....	600	Brandy freezes....	7
Bismuth melts.....	497	Mercury freezes.....	-39½

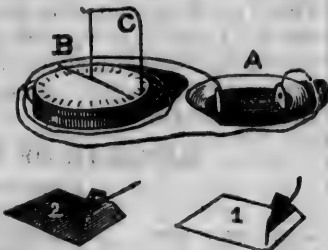
STEAM PRESSURE AND TEMPERATURE.

Pressure in lbs. p'r sq. in.	Correspond'g Temperature. Fahrenheit.	Pressure in lbs. p'r sq. in.	Correspond'g Temperature. Fahrenheit.	Pressure in lbs. p'r sq. in.	Correspond'g Temperature. Fahrenheit.
10	192.4	65	301.3	140	357.9
15	212.8	70	306.4	150	363.4
20	228.5	75	311.2	160	368.7
25	241.0	80	315.8	170	373.6
30	251.6	85	320.1	180	378.4
35	260.9	90	324.3	190	382.9
40	269.1	95	328.2	200	387.3
45	276.4	100	332.0	210	391.5
50	283.2	110	339.2	220	395.5
55	289.3	120	345.8	230	399.4
60	295.6	130	352.1	240	403.1

ELECTRIC BATTERIES AND MAGNETS.

THE following directions, if carefully followed, will enable any person to make a working galvanic battery, electro-magnet, and a needle telegraph, all at a cost of not exceeding ten or twenty cents:

Take a bit of common sheet zinc—stove zinc—six inches long, four inches wide. Bend it up two inches from the end, nick the bent end, and wind the naked end of a copper wire around the zinc at the nick. Use copper wire, size of a common pin—insulated wire, that is, copper wire covered with thin paper or cotton, or paint or varnish. Leave the ends of the wires uncovered. Cover the zinc with common white printing paper, two thicknesses, as shown at 1. The white represents the paper. Provide a bit of thin sheet lead, same size as the zinc, bent in and nicked, but not covered with paper. Attach one end of a copper wire, as shown at 2.



Provide a common tea saucer, in which place one ounce of sulphate of copper (to be had for a few cents at any drug-store); pour on warm water; fill saucer two thirds full; let stand until dissolved. Now put the zinc (1) in saucer, and put the lead (2) on top of the zinc, the ends standing above the liquid as shown. You now have a complete and tolerably strong galvanic battery. When the free ends of the two wires are touched together, a spark will be seen at the moment of junction. The circuit is made or closed by placing the two wires together. The circuit is opened or broken by separating the wires.

An electro-magnet may be made by providing a small wrought-iron staple, and grinding off the pointed ends. Wind both legs with the insulated copper wire. The mode of winding and carrying the wire from one leg to the other is shown in the cut. Both legs should, when finished, be closely wound, as shown on the left side.



Now connect the end of the wire of one of the legs with one of the battery wires, and the wire of the other leg with the other battery wire, and you will find that the staple is magnetized. The magnetism ceases when the wires are separated. Put a steel knife blade on one leg of the magnet, and the knife becomes permanently magnetized.

102 ELECTRIC BATTERIES AND MAGNETS.

A needle drawn across the magnet is also magnetized, and if suspended by a thread it becomes a compass, and will point north and south. To make such a compass, magnetize a sewing needle; suspend it by a silk fibre drawn from a piece of sewing silk; attach the silk to a bit of bent wire, C, the bottom of which is stuck into, and supported by, a piece of round cork, as shown in the first cut.

Place the compass thus made on a table, and the needle will point north and south. Now place loosely on the table, around the cork base, two coils or turns of the insulated wire. Connect one end of the wire with one of the battery wires. Join the other end of the coil wire to the other battery wire. An electrical current will now go through the coil, which will move the needle. This is the needle telegraph. By alternately separating and joining the wire of the battery and the coil wire, the needle swings. One swing may be called A; two swings, B; three, C, etc. In this way intelligible signals are sent. A needle smaller than that here shown in the cut is used for telegraphing through the cable under the Atlantic Ocean between Europe and America. On land lines in England larger needles are used, but in this country a magnet is used which draws down a lever with such force as to make a click. A long click and a short click mean A; a short click, E; two short clicks, I. The battery wire and the coil wire are alternately joined and separated by a pivoted finger lever called a key.

HEAT AND ELECTRICAL CONDUCTIVITY.

SUBSTANCES.	HEAT CONDUCTIVITY.	ELECTRICAL CONDUCTIVITY.
Silver.....	100.0	100.0
Copper.....	73.6	73.3
Gold.....	53.2	58.5
Brass.....	23.6	21.5
Zinc.....	19.9	...
Tin.....	14.5	22.6
Steel.....	12.0	...
Iron.....	11.9	13.0
Lead.....	8.5	10.7
Platinum.....	6.4	10.3
Palladium.....	6.3	...
Bismuth.....	1.8	1.9

DISTINGUISHED AMERICAN INVENTORS.

BENJAMIN FRANKLIN; b. Boston, 1706; d. 1790; at 12, printer's apprentice, fond of useful reading; 27 to 40, teaches himself Latin, etc., makes various useful improvements; at 40 studies electricity; 1752, brings electricity from clouds by kite, and invents the lightning-rod.

ELI WHITNEY, inventor of the cotton-gin; b. Westborough, Mass., 1765; d. 1825; went to Georgia 1792 as teacher; 1793 invents the cotton-gin, prior to which a full day's work of one person was to clean by hand one pound of cotton; one machine performs the labor of five thousand persons; 1800, founds Whitneyville, makes firearms, by the interchangeable system for the parts.

ROBERT FULTON; b. Little Britain, Pa., 1765; d. 1825; artist painter; invents steamboat 1793; invents submarine torpedoes 1797 to 1801; builds steamboat in France 1803; launches passenger-boat Clermont at N. Y. 1807, and steams to Albany; 1812, builds steam ferryboats; 1814, builds first steam war-vessel.

JETHRO WOOD, inventor of the modern cast-iron plough; b. White Creek, N. Y., 1774; d. 1834; patented the plough 1814. Previously the plough was a stick of wood plated with iron. Lawsuits against infringers consumed his means. Secretary Seward said: "No man has benefited the country pecuniarily more than Jethro Wood, and no man has been as inadequately rewarded."

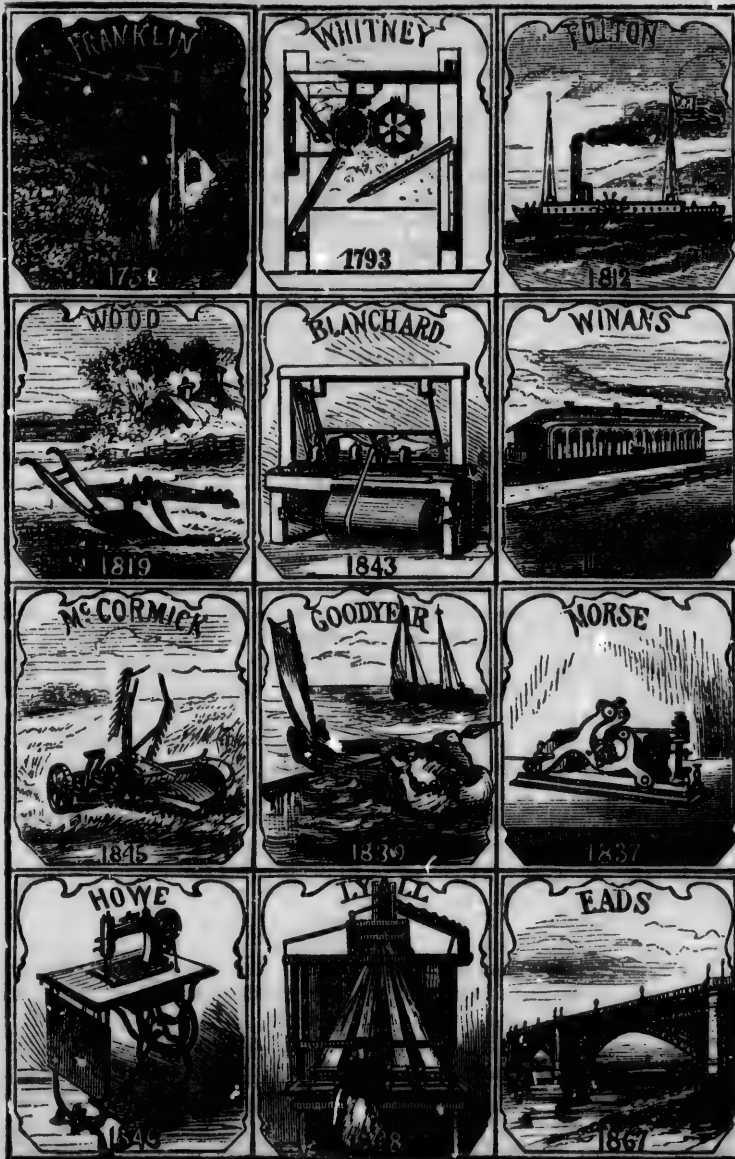
THOMAS BLANCHARD; b. 1788, Sutton, Mass.; d. 1864; invented tack machine 1806; builds successful steam carriage 1825; builds the stern-wheel boat for shallow waters, now in common use on Western rivers; 1843, patents the lathe for turning irregular forms, now in common use all over the world for turning lasts, spokes, axe-handles, gun-stocks, hat-blocks, tackle-blocks, etc.

ROSS WINANS, of Baltimore; b. 1798, N. J.; author of many inventions relating to railways; first patent, 1828; he designed and patented the pivoted, double-truck, long passenger cars now in common use. His genius also assisted the development of railways in Russia.

CYRUS H. MCCORMICK, inventor of harvesting machines; b. Walnut Grove, Va., 1809; in 1851 he exhibited his invention at the World's Fair, London, with practical success. The mowing of one acre was one day's man's work; a boy with a mowing-machine now cuts 10 acres a day. Mr. McCormick's patents made him a millionaire.

CHARLES GOODYEAR, inventor and patentee of the simple mixture of rubber and sulphur, the basis of the present great





rubber industries throughout the world; b. New Haven, Conn., 1800; in 1839, by the accidental mixture of a bit of rubber and sulphur on a red-hot stove, he discovered the process of vulcanization. The Goodyear patents proved immensely profitable.

SAMUEL F. B. MORSE, inventor and patentee of electric telegraph; b. Charlestown, Mass., 1791; d. 1872; artist painter; exhibited first drawings of telegraph 1832; half-mile wire in operation 1835; caveat 1837; Congress appropriated \$30,000, and in 1844 first telegraph line from Washington to Baltimore was opened; after long contests, the courts sustained his patents, and he realized from them a large fortune.

ELIAS HOWE, inventor of the modern sewing-machine; b. Spencer, Mass., 1819; d. 1867; machinist; sewing-machine patented 1846. From that time to 1854 his priority was contested, and he suffered from poverty, when a decision of the courts in his favor brought him large royalties, and he realized several millions from his patent.

JAMES B. EADS; b. 1820; author and constructor of the great steel bridge over the Mississippi at St. Louis, 1867, and the jetties below New Orleans 1876. His remarkable energy was shown in 1861, when he built and delivered complete to Government, all within sixty-five days, seven iron-plated steamers, 600 tons each; subsequently other steamers. Some of the most brilliant successes of the Union arms were due to his extraordinary rapidity in constructing these vessels.

JAMES LYALL, N. Y. City; b. 1836; invented a simple mixture, 1863, for enamelling cloth for knapsacks, etc., from which he realized a fortune; in 1868 patented the positive-motion loom, from which patent he has acquired great riches; is the founder and manager of several great establishments; at one of these, Twenty-third street, N. Y., 4000 hands are employed. This loom increases the production and lessens the cost of woven fabrics. A single loom, attended by one girl, turns out 320 square yards in 10 hours, the fabric being 8 yards or more wide.

THE first recorded patent granted by the United States Government bears date July 31st, 1790, issued to Samuel Hopkins for making pot and pearl ashes. Two other patents were granted in that year. In the following year, 1791, thirty-three patents were granted. Among them were six patents to James Rumsay and one to John Fitch for inventions relating to steam-engines and steam-vessels. For the single year of 1876, the number of patents and caveats applied for was almost twenty thousand.

MECHANICAL MOVEMENTS.

IN the construction of models, or machinery, the skilful mechanic and inventor will study to avoid clumsiness in the arrangement of parts, and will naturally take pride in selecting, as far as possible, the simplest and best forms of mechanical movements. As suggestive for this purpose we have brought together and condensed an extensive series of mechanical movements. Here the mechanic may find at a glance the movement suited for his purpose, and may see the separate parts best adapted to any special combination of mechanism.

The following is a brief description of the various movements, as numbered :

1. Shaft coupling. 2. Claw coupling. 3, 4. Lever couplings. On the driving shaft, a disk with spurs is mounted, and to the shaft to be driven a lever is hinged. By causing this lever to catch in the spurs of the disk, the coupling is effected. 5. Knee or rose coupling, of which 26 is a side view.

6. Universal joint. 7, 8. Disk and spur coupling. 9. Prong and spur lever coupling.

10. Fast and loose pulley. 11. Sliding gear, the journal boxes of one of the wheels being movable. 12. Friction clutch. By tightening or releasing a steel band, encircling a pulley on the shaft, the machinery is thrown in or out of gear. 13, 14. Shoe and lever brakes. 15, 16. Change of motion by sheaves. 17. Spiral flanged shaft. 18. Connected with the rod are pawl links, catching into ratchet-teeth in the wheel to which rotary motion is to be imparted. When the rod moves in one direction, one of the pawls acts; and when the rod moves in the opposite direction, the other pawl acts in the same direction as the first. 19. The reciprocating motion of a rod is converted into rotary motion of the fly-wheel by a weight suspended from a cord, which passes over a small pulley that connects with a treadle, from which the motion is transmitted to the fly-wheel.

20. "Flying horse," used in fairs for amusement. By pulling the cords radiating from the crank, the persons occupying the seats or horses on the ends of the arms are enabled to keep the apparatus in motion. 21, 22. Bow-string arrangements, to connect reciprocating into rotary motion. 23. Same purpose by differential screw. 24. The same by double rack and wheels. 25. Coupling for square shafts. 26. Side view of Fig. 5. 27. Sliding-spur pulley coupling. 28. Lever with bearing roller to tighten pulley bands. 29. Chain wheel.

30. Reciprocating rectilinear into reciprocating rotary

motion by two racks and cog-wheel. 31. Oblique-toothed wheels. 32. Worm and worm-wheel. 33, 34. Claw coupling with hinged lever. 35, 36. Disk couplings, with lugs and cavities. 37. Disk coupling with screw bolts. 38, 39, 40. Shaft couplings.

41. Face view of Fig. 12. 42. Friction cones. 43. Friction pulleys. 44. Self-releasing coupling. Disks with oblique teeth. If the resistance to the driven shaft increases beyond a certain point, the disks separate. 45. Hoisting blocks. 46. Elbow crank, for changing motion. 47. Reciprocating into rotary motion by zigzag groove on cylinder. 48. Another form of Fig. 29. 49. Reciprocating into a rotary motion.

50. Same purpose. 51. Same purpose, by double rack and two ratchet pinions. When the double rack moves in one direction, one pinion is rigid with the shaft; when the rack moves in the opposite direction, the other pinion is rigid, and a continuous rotary motion is imparted to the fly-wheel shaft. 52. Reciprocating into oscillating. 53. Rotary into reciprocating. By the action of the wheel-pins the carriage is moved in one direction, and by the action of said pins on an elbow-lever, it is moved in the opposite direction. 54. Stamp rod and lifting cam. 55. For giving reciprocating motion to rack. 56. Same motion to a bar with slot, by means of an eccentric pin projecting from a revolving disk, and catching in the slot. 57. Walking-beam and fly-wheel. 58. Reciprocating motion to pump or other rod by means of eccentric disk and friction rollers. See 81 and 104. 59. Hoisting crane.

60. Friction gears. See 43. 61. Rotary into reciprocating by rising and falling pinion acting on endless rack. 62. By the revolving cam, a rising and falling or a reciprocating rectilinear motion is imparted to a drum. 63. Reciprocating motion to a frame by means of endless rack and pinion. 64. Reciprocating rectilinear motion to a toothed rack by a toothed segment on a lever-arm, which is subjected to the action of a weight, and of an eccentric wrist-pin, projecting from a revolving disk. 65. Reciprocating motion to a rod. The wheels are of different diameters, and consequently the rod has to rise and fall as the wheels revolve. (See 110.) 66. Cam and elbow lever. 67. Rod reciprocates by means of cam. 68. Revolving into reciprocating motion, by an endless segmental rack and pinion, the axle of which revolves and slides in a slot toward and from the rack. This rack is secured to a disk, and a rope round said disk extends to the body to which a reciprocating motion is to be imparted. 69. Elliptic gears. *add no other was this yet*

70. Bevel gear. 71. Worm and worm wheel. 72. Transmitting motion from one axle to another, with three different velocities, by means of toothed segments of unequal diameters. 73. Continuous revolving into reciprocating, by a cam-disk acting on an oscillating lever. 74. Intermittent revolving motion to a shaft with two pinions, and segment gear-wheel on end of shaft. 75. Oscillating lever, carrying pawls which engage teeth in the edges of a bar to which rectilinear motion is imparted. 76. Oscillating lever, connects by a link with a rod to which a rectilinear motion is imparted. 77. Oscillating lever and pawls, which gear in the ratchet-wheel. 78. Common treadle. 79. Describing on a revolving cylinder a spiral line of a certain given pitch which depends upon the comparative sizes of the pinion and bevel-wheels.

80. Marking a spiral line, the graver moved by a screw. 81. (See Fig. 58.) 82. Plunger and rods. 83. Crosshead and rods. 84. Reciprocating rod guided by friction rollers. 85. Revolving into reciprocating motion, by means of roller-arms, extending from a revolving shaft, and acting on lugs projecting from a reciprocating frame. 86. Crank motion. 87. Reciprocating motion by toothed wheel and spring bar. 88. The shaft carries a taper, which catches against a hook hinged to the drum, so as to carry said drum along and raise the weight on the rope. When the tappet has reached its highest position, the hook strikes a pin, the hook disengages from the tappet, and the weight drops. 89. Reciprocating motion to a rod by means of a groove in an oblique ring secured to a revolving shaft.

90. Double crank. 91. Cam groove in a drum, to produce reciprocating motion. 92. Belts and pulleys. 93. Pulleys, belts, and internal gear. 94. As the rod moves up and down, the teeth of the cog-wheel come in contact with a pawl, and an intermittent rotary motion is imparted to said wheel. 95. By turning the horizontal axles with different velocities, the middle wheel is caused to revolve with the mean velocity. 96. Oscillating lever and cam groove in a disk. 97. Lazy tongs. 98. Oscillating segment and belt over pulleys. 99. Converting oscillating into a reciprocating motion by a cam-slot in the end of the oscillating lever which catches over a pin projecting from one of the sides of a parallelogram which is connected to the rod to which reciprocating motion is imparted.

100. Oscillating motion of a beam into rotary motion. 101. Motion of a treadle into rotary motion. 102. Double-acting beam. 103. Single-acting beam. 104. (See Figures 58 and 81.) 105. Device to steady a piston by a slotted guide-piece, operated by an eccentric on the driving-shaft.

106. Rod operated by two toothed segments. 107. Two cog-wheels of equal diameter, provided with a crank of the same length, and connected by links with a cross-bar to which the piston-rod is secured. 108. Device for a rectilinear motion of a piston-rod based on the hypocycloidal motion of a pinion in a stationary wheel with internal gear. If the diameter of the pinion is exactly equal to one half the diameter of the internal gear, the hypocycloid becomes a eight line. 109. Same purpose as 56.

110. Action similar to 65. 111. Revolving motion by a circular sliding pinion gearing in an elliptical cog-wheel. 112. Similar to 96. 113. Carpenter's clamp. The jaws turn on their pivot-screws, and clamp the board. 114. An irregular vibratory motion is given to the arm carrying the wheel A, by the rotation of the pinion B. 115. Intermittent rotary motion of the pinion-shaft, by the continuous rotary motion of the large wheel. The part of the pinion shown next the wheel is cut on the same curve as the plain portion of the circumference, and, therefore, serves as a lock whilst the wheel makes a part of a revolution, and until the pin upon the wheel strikes the guide-piece upon the pinion, when the pinion-shaft commences another revolution. 116. Stop-motion used in watches to limit the number of revolutions in winding up. The convex curved part, *a*, *b*, of the wheel B, serving as the stop. 117. Several wheels, by connecting-rods, driven from one pulley. 118. Intermittent circular motion is imparted to the toothed wheel by vibrating the arm B. When the arm B is lifted, the pawl is raised from between the teeth of the wheel, and travelling backward over the circumference again, drops between two teeth on lowering the arm, and draws with it the wheel. 119. Reciprocating rectilinear motion is given to the bar by the continuous motion of the cam. The cam is of equal diameter in every direction measured across its centre.

120. Mechanism for revolving the cylinder in Colt's fire-arms. When the hammer is drawn back the dog, *a*, attached to the tumbler, acts on the ratchet, *b*, on the back of the cylinder, and is held up to the ratchet by a spring, *c*. 121. Alternate increasing and diminishing motion, by means of eccentric toothed wheel and toothed cylinder. 122. Oscillating or pendulum engine. The cylinder swings between trunnions like a pendulum. The piston-rod connects directly with crank. 123. Intermittent rotary motion. The small wheel is driven, and the friction rollers on its studs move the larger wheel by working against the faces of oblique grooves or projections across the face thereof. 124. Longitudinal and rotary motion of the rod is produced by its arrangement

between two rotating rollers, the axles of which are oblique to each other. 125. Friction indicator of Roberts. Upon the periphery of the belt-pulley a loaded carriage is placed, its tongue connected with an indicator. With a given load the indicating pointer remains in a given position, no matter what velocity is imparted to the pulley. When the load is changed the indicator changes, thus proving that the friction of wheels is in proportion to load, not velocity. 126. Circular intermittent rectilinear reciprocating motion. Used on sewing-machines for driving the shuttle; also on three-revolution cylinder printing-presses. 127. Continuous circular into intermittent circular motion. The cam is the driver. 128. Sewing-machine, four-motion feed. The bar B carries the feeding-points or spurs, and is pivoted to slide A. B is lifted by a radial projection on cam C, which at the same time also carries A and B forward. A spring produces the return stroke, and the bar, B, drops by gravity. 129. Patent crank motion, to obviate dead centres. Pressure on the treadle moves the slotted slide A forward until the wrist passes the centre, when the spring B forces the slide against the stops until next forward movement.

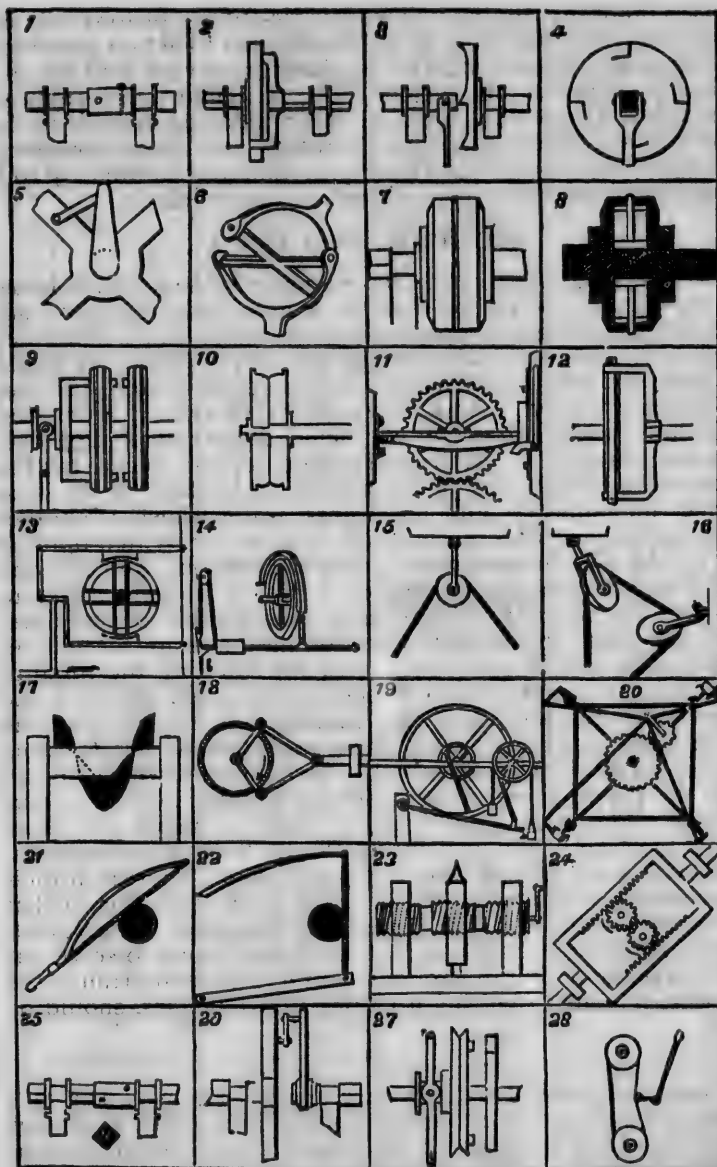
130. Four-way cock. 131. One stroke of the piston gives a complete revolution to the crank. 132. Rectilinear motion of variable velocity is given to the vertical bar by rotation of the shaft of the curved arm. 133. Pantagraph for copying, enlarging, and reducing plans, etc. C, fixed point. B, ivory tracing point. A, pencil trace, the lines to be copied with, and B, the pencil, will reproduce it double size. Shift the slide to which C is attached, also the pencil slide, and size of the copy will be varied. 134. Ball-and-socket joint for tubing. 135. Numerical registering device. The teeth of the worm shaft-gear with a pair of worm-wheels of equal diameter, one having one tooth more than the other. If the first wheel has 100 teeth and the second 101, the pointers will indicate respectively 101 and 10.100 revolutions. 136. Montgolfier's hydraulic ram. The right hand valve being kept open by a weight or spring, the current flowing through the pipe in the direction of the arrow, escapes thereby. When the pressure of the water current overcomes the weight of the right valve, the momentum of the water opens the other valve, and the water passes into the air-chamber. On equilibrium taking place, the left valve shuts and the right valve opens. By this alternate action of the valves, water is raised into the air-chamber at every stroke. 137. Rotary engine. Shaft B and hub C are arranged eccentric to the case. Sliding radial pistons, *a, a*, move in and out of hub, C. The pistons slide through rolling packings in the hub C.

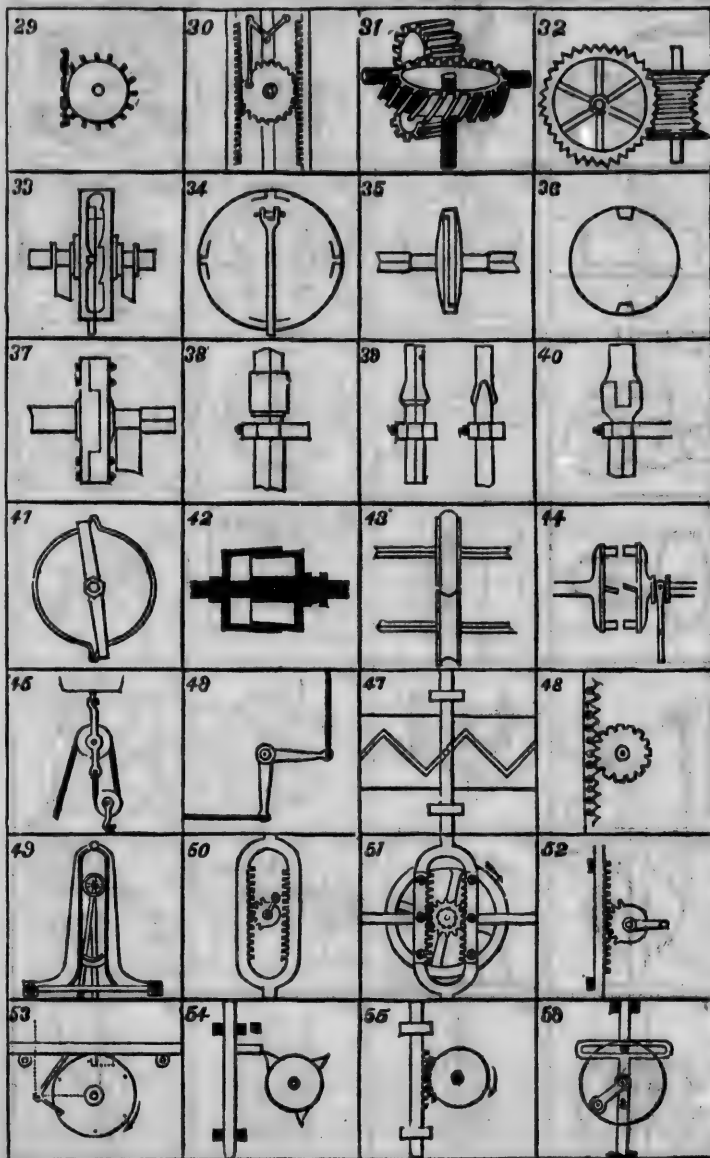
138. Quadrant engine. Two single-acting pistons, B, B, connect with crank D. Steam is admitted to act on the outer sides of the pistons alternately through valve *a*, and the exhaust is between the pistons. 139. Circular into rectilinear motion. The scolloped wheel communicates motion to the horizontal oscillating rod, and imparts rectilinear movement to the upright bar. 140. Rotary motion transmitted by rolling contact between two obliquely arranged shafts.

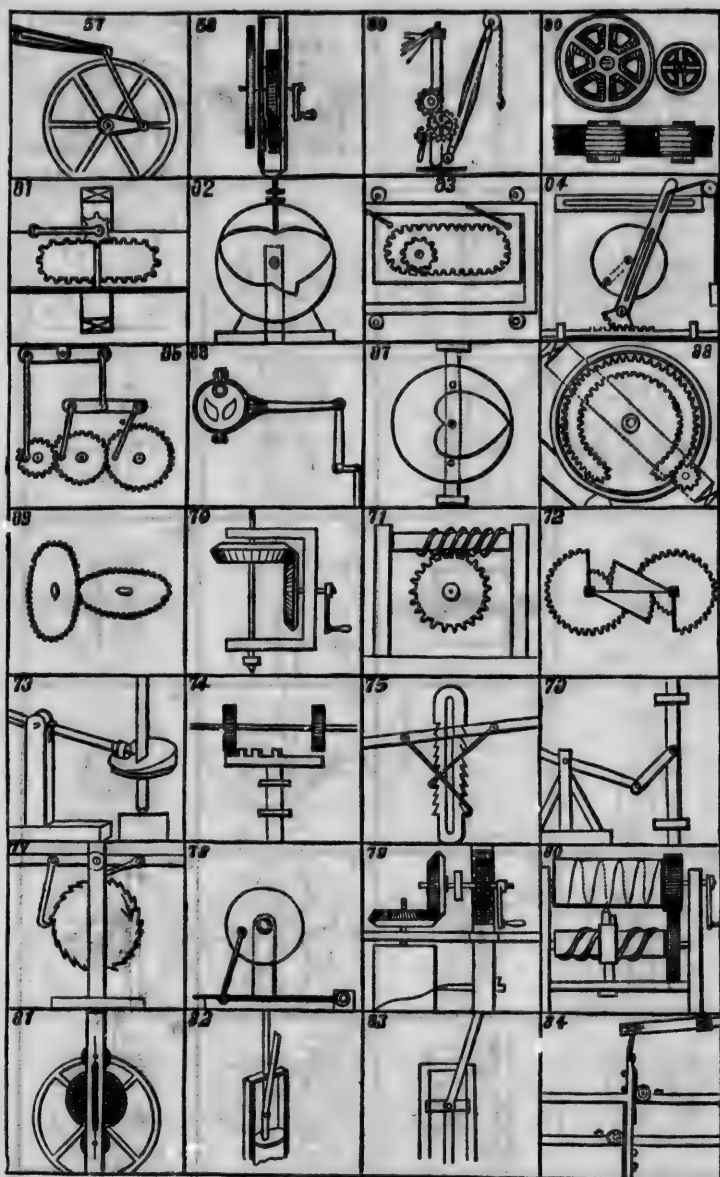
MULTUM IN PARVO.

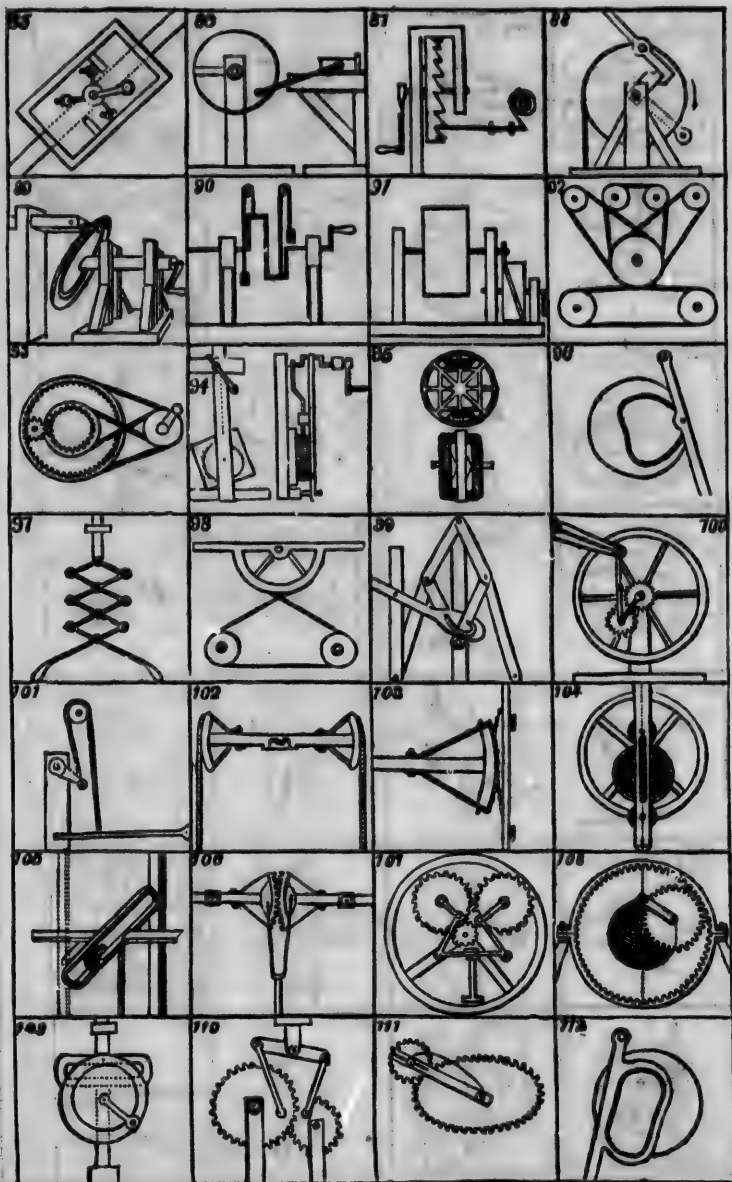
WE have some queer correspondents: One writes to know if we will not be so good as to send a messenger to an address which he gives, up town—distance two and a half miles from our office—to make certain inquiries for him. It would require one and a half hours' time to do the errand, and not a stamp inclosed. Another wants us to write a letter and tell him where to get a combined thermometer and barometer. Another, "Will you be good enough to give me the names and addresses of several of the makers of the best brick machines?" another wants water-wheels; another threshing machines: each writer desires our written opinion as to which is the best device, with our reasons, and not one is thoughtful enough to inclose a fee, or to reflect that to answer his request will consume considerable of our time. Another party wishes us to write to him the recipe for making ornaments out of coal tar, where he can buy the mixture ready for use, and how much chequer-men will sell for in the New York market. For this information he sends us the generous sum of three cents in postage stamps. Mr. C wants us to tell him of some valuable invention, of which he can buy the patent cheap, that would be suitable for him to take to sell, on his travels out West, by towns, counties, etc., three cents inclosed. Others want us to put them in communication with some person who will purchase an interest in their inventions, or manufacture for them, or furnish this or that personal information, our reply to be printed in **THE SCIENTIFIC AMERICAN**. We are at all times happy to serve our correspondents, but if replies to purely personal errands are expected, a small fee, say from one to five dollars, should be sent.

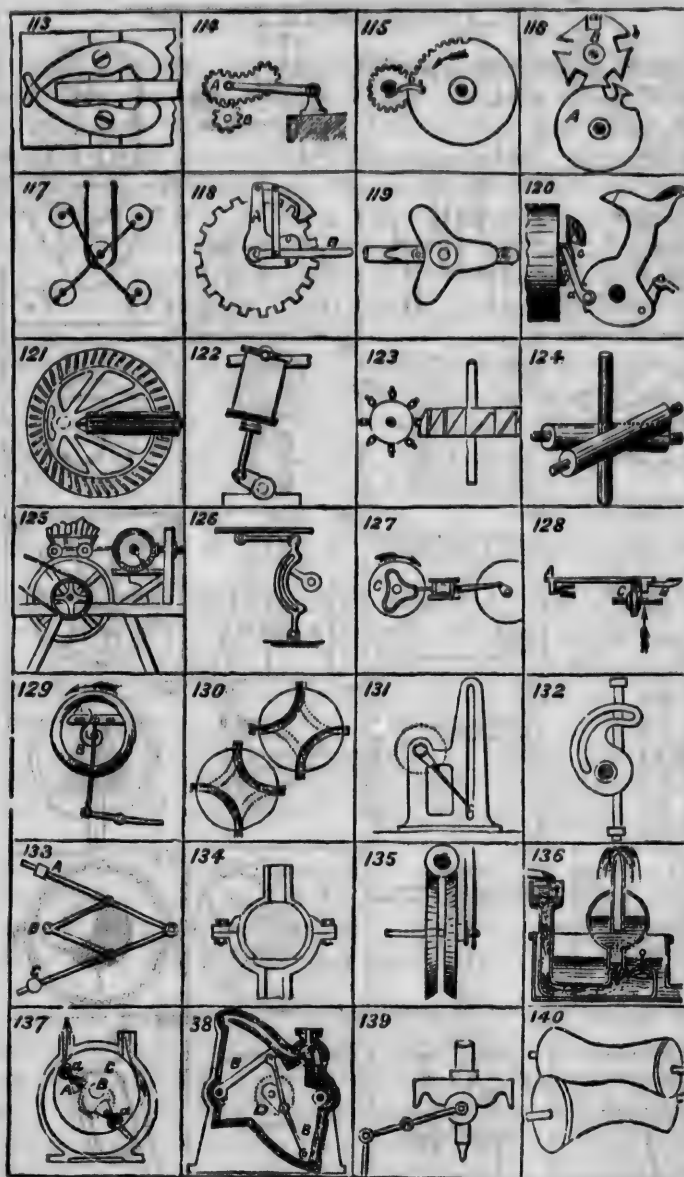
HARNESS BLACKING.—Melt 1 pound bees-wax, stir in 4 ounces ivory-black, 2 ounces spirits turpentine, 2 ounces Prussian blue ground in oil, and $\frac{1}{2}$ ounce copal varnish. Make into balls. With a brush apply it to harness, and polish with silk gently.











HORSE-POWER.

WHEN Watt began to introduce his steam-engines he wished to be able to state their power as compared with that of horses, which were then generally employed for driving mills. He accordingly made a series of experiments, which led him to the conclusion that the average power of a horse was sufficient to raise about 33,000 lbs. one foot in vertical height per minute, and this has been adopted in England and this country as the general measure of power.

A waterfall has one horse-power for every 33,000 lbs. of water flowing in the stream per minute, for each foot of fall. To compute the power of a stream, therefore, multiply the area of its cross section in feet by the velocity in feet per minute, and we have the number of cubic feet flowing along the stream per minute. Multiply this by $62\frac{1}{2}$, the number of pounds in a cubic foot of water, and this by the vertical fall in feet, and we have the foot-pounds per minute of the fall; dividing by 33,000 gives us the horse-power.

For example: A stream flows through a flume 10 feet wide, and the depth of the water is 4 feet; the area of the cross section will be 40 feet. The velocity is 150 feet per minute— $40 \times 150 = 6000$ —the cubic feet of water flowing per minute. $6000 \times 62\frac{1}{2} = 375,000$ —the pounds of water flowing per minute. The fall is 10 feet; $10 \times 375,000 = 3,750,000$ —the foot-pounds of the water-fall. Divide 3,750,000 by 33,000, and we have $113\frac{1}{3}$ as the horse-power of the fall.

The power of a steam-engine is calculated by multiplying together the area of the piston in inches, the mean pressure in pounds per square inch, the length of the stroke in feet, and the number of strokes per minute; and dividing by 33,000.

Water-wheels yield from 50 to 91 per cent of the water. The actual power of a steam-engine is less than the indicated power, owing to a loss from friction; the amount of this loss varies with the arrangement of the engine and the perfection of the workmanship.

PROPERTIES OF CHARCOAL.

ALTHOUGH charcoal is so combustible, it is, in some respects a very unchangeable substance, resisting the action of a great variety of other substances upon it. Hence posts are often charred before being put into the ground. Grain has been found in the excavations at Herculaneum, which was charred at the time of the destruction of that city, eighteen hundred years ago, and yet the shape is perfectly preserved, so that you can distinguish between the different kinds of grain. While charcoal is itself so unchangeable, it preserves other substances from change. Hence meat and vegetables are packed in charcoal for long voyages, and the water is kept in casks which are charred on the inside. Tainted meat can be made sweet by being covered with it. Foul and stagnant water can be deprived of its bad taste by being filtered through it. Charcoal is a great decolorizer. Ale and porter filtered through it are deprived of their color, and sugar-refiners decolorize their brown syrups by means of charcoal, and thus make white sugar. Animal charcoal, or bone-black, is the best for such purposes, although only one-tenth of it is really charcoal, the other nine-tenths being the mineral portion of the bone.

Charcoal will absorb, of some gases, from eighty to ninety times its own bulk. As every point of its surface is a point of attraction, it is supposed to account for the enormous accumulation of gases in the spaces of the charcoal. But this accounts for it only in part. There must be some peculiar power in the charcoal to change, in some way, the condition of a gas of which it absorbs ninety times its own bulk.—*Hooker.*

SUBSTITUTE FOR THE CRANK.



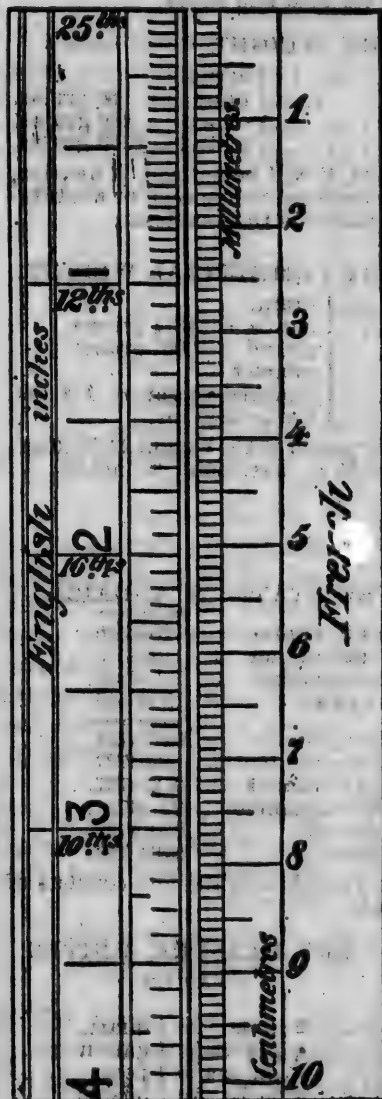
VARIOUS devices supposed to have advantages over the common crank, have been invented. Our diagram shows one of these forms, which has been re-invented many times, by different inventors. A grooved wheel is employed, and in the groove are two slides, attached respectively, by pivots, to the connecting rod of a piston rod. The reciprocating movement of the piston rod acting upon the connecting rod, causes the rotation of the wheel.

THE knots represented on the preceding page of engravings are as follows:

- | | |
|------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Simple overhand knot. | 32. Rosette. |
| 2. Slip-knot seized. | 33. Chain-knot. |
| 3. Single bow-knot. | 34. Double chain-knot. |
| 4. Square or ruf-knot. | 35. Double running-knot,
with check-knot. |
| 5. Square bow-knot. | 36. Double twist-knot. |
| 6. Weaver's knot. | 37. Builders' knot. |
| 7. German or figure-of-8
knot. | 38. Double Flemish knot. |
| 8. Two half-hitches, or ar-
tificer's knot. | 39. English knot. |
| 9. Double artificer's knot. | 40. Shortening-knot. |
| 10. Simple galley-knot. | 41. Shortening-knot. |
| 11. Capstan or prolonged
knot. | 42. Sheep-shank. |
| 12. Bowline-knot. | 43. Dog-shank. |
| 13. Rolling-hitch. | 44. Mooring-knot. |
| 14. Clove-hitch. | 45. Mooring-knot. |
| 15. Black wall-hitch. | 46. Mooring-knot. |
| 16. Timber-hitch. | 47. Pigtail worked on the
end of a rope. |
| 17. Bowline on a bight. | 48. Shroud-knot. |
| 18. Running bowline. | 49. A bend or knot used by
sailors in making fast to
a spar or a bucket-han-
dle before casting over-
board ; it will not run.
Also used by horsemen
for a loop around the jaw
of a colt in breaking :
the running end, after
passing over the head of
the animal and through
the loop, will not jam
therein. |
| 19. Catspaw. | 50. A granny's knot. |
| 20. Doubled running-knot. | 51. A weaver's knot. |
| 21. Double knot. | |
| 22. Six-fold knot. | |
| 23. Boat-knot. | |
| 24. Lark's head. | |
| 25. Lark's head. | |
| 26. Simple boat-knot. | |
| 27. Loop-knot. | |
| 28. Double Flemish knot. | |
| 29. Running-knot checked | |
| 30. Crossed running-knot. | |
| 31. Lashing-knot. | |

The principle of a knot is, that no two parts which would move in the same direction if the rope were to slip, should lie alongside of and touching each other.

MEASURES OF LENGTH.—The subjoined engraving shows at the left a four-inch section of a common rule, the inch divisions being subdivided into twenty-fifths, twelfths, eighths, and tenths. On the right is the French measure, indicating millimetres and centimetres. The French metre is intended to be the one ten-millionth part of the distance from either pole of the earth to the equator.



FRENCH MEASURE, UNITED STATES STANDARD.

10 millimetres make	1 millimetre	= $\frac{1}{25}$ of an inch nearly, or	.0393685 inch.
10 centimetres	1 centimetre	= $\frac{1}{2}$ of an inch fall, or	.393685 inches.
10 decimetres	1 decimetre	= 4 inches nearly, or	3.93685 inches.
10 metres	1 metre	= 3 feet 3 $\frac{3}{4}$ inches +, or	39.3685 inches.
10 decametres	1 decametre	= 32.871 feet, or	393.685 inches.
10 hectometres	1 hectometre	= 328.071 feet, or	.0621347 mile.
10 kilometres	1 kilometre	= 3280.71 feet, $\frac{2}{3}$ or	.6213466 mile.
	1 myriametre	= 32807.1 feet, $\frac{6}{7}$ or	6.213466 miles.

COMMON LONG MEASURE.

12 inches make	1 foot.	40 rods make	1 furlong = 930 yards = 660 feet.
3 feet	" 1 yard = 36 inches.	8 furlongs	" 1 statute or land mile = 1760 yds. = 5280 ft.
5 $\frac{1}{2}$ yards	" 1 rod, pole or perch = 16 $\frac{1}{2}$ feet.	3 miles	" 1 league.

A point = $\frac{1}{16}$ inch. A line = 6 points = $\frac{3}{8}$ inch. A palm = 3 inches. A span = 9 inches. A hand = 4 inches. A fathom = 6 feet. A cable's length = 120 fathoms = 720 feet. A Gunter's chain = 66 feet = 4 rods. 80 Gunter's chains = 1 mile. A nautical or sea-mile = 6086.07 feet, or $\frac{1}{11}$ part of the earth's circumference at the equator = 1.159664 geographical or land miles. 1 degree at equator = 69.160 land miles. 1 land mile = .86755 of a nautical mile.

TROY WEIGHT.

24 grains.....	1 pennyweight, dwt.
20 pennyweights.....	1 ounce = 480 grains.
12 ounces.....	1 pound = 5760 grains.

Troy weight is used for gold and silver.

APOTHECARIES' WEIGHT.

20 grains.....	1 scruple.
3 scruples.....	1 dram = 60 grains.
8 drams.....	1 ounce = 480 grains.
12 ounces.....	1 pound = 5760 grains.

The ounce in the above measures, it will be noticed, is heavier, contains more grains than the common commercial or avoirdupois weight, but the avoirdupois pound is the heaviest.

AVOIRDUPOIS OR ORDINARY COMMERCIAL WEIGHT.

27.34 + grains.....	1 dram.
16 drams.....	1 ounce = 437½ grains.
16 ounces.....	1 pound = 7000 grains.
28 pounds.....	1 quarter.
4 quarters.....	1 hundredweight = 112 lbs.
20 hundredweight.....	1 ton = 2240 lbs.

The standard of the avoirdupois pound is the weight 27.7015 cubic inches of distilled water at 80°.85 F., barometer 30 inches.

A troy oz. = 1.09714 avoirdupois oz.

An avoirdupois oz. = .911458 troy oz.

A stone = 14 lbs. A quintal = 100 lbs.

FRENCH WEIGHTS (UNITED STATES STANDARD).

		Grains avoirdupois.
10 milligrammes make	1 milligramme	= .0154324.
10 centigrammes "	1 centigramme	= .154324.
10 decigrammes "	1 decigramme	= 1.54324.
	1 GRAMME	= 15.4324.
		Pounds avoirdupois.
10 grammes "	1 decagramme	= .02204737.
10 decagrammes "	1 hectogramme	= .2204737.
10 hectogrammes "	1 KILOGRAMME	= 2.204737.
10 kilogrammes "	1 myriogramme	= 22.04737.
10 myriogrammes "	1 quintal	= 220.4737.
10 quintals "	1 tonne	= 2204.737.

The gramme is the basis of the French weights, and consists of a cubic centimetre of distilled water.

SQUARE OR LAND MEASURE, UNITED STATES.

144 sq. inches =	1 sq. foot.
9 sq. feet =	1 sq. yard.
80½ sq. yards =	1 sq. rod.
40 sq. rods =	1 sq. rood.
4 sq. roods =	1 sq. acre.

DRY MEASURE, UNITED STATES.

2 pints =	1 quart.
4 quarts =	1 gallon.
2 gallons =	1 peck.
4 pecks =	1 bushel.

physical or land miles. 1 degree at equator = 69.160 land miles. 1 land mile = .8685 of a nautical mile.

CUBIC OR SOLID MEASURE

1728 cubic ins. = 1 cubic foot.
 27 cubic feet = 1 cubic yard.

2 hogsheads = 1 pipe or butt.
 2 pipes = 1 tun.

LIQUID MEASURE, UNITED STATES.

4 gills = 1 pint.
 2 pints = 1 quart.
 4 quarts = 1 gallon.
 63 gallons = 1 hogshead.

1 barrel = 31½ gallons.
 1 gallon = 231 cubic inches.
 1 bushel = 1.24445 cub. ft.
 1 barrel flour = 196 lbs. = 3 bush.

A cylinder seven inches diameter and six inches high contains a gallon.

FRENCH SQUARE MEASURE, U. S.

Square inches.
 1 square millimetre = .001549.
 1 square centimetre = .154988.
 1 square decimetre = 15.4988.

Square feet.
 1 square metre = 10.763058.
 1 square decametre = 1076.3058.
 1 square decare = 10763.058.

U. S. acres.
 1 square hectare = 2.47086.
 1 square kilometre = 247.086.
 1 square myriametre = 24708.6.

FRENCH CUBIC OR SOLID MEASURE, U. S.

Cubic inches.
 Millitre or cubic centimetre..... = .0610165.
 10 millilitres make 1 centilitre = .610165.
 10 centilitres " 1 decilitre = 6.10165.
 10 decilitres " 1 litre = 61.0165.
 10 litres " 1 decalitre = 610.165.

Cubic feet.
 10 decalitres " 1 hectolitre = 3.53105.
 10 hectolitres " 1 kilolitre or cubic metre = 35.3105.
 10 kilolitres " 1 myriolitre = 353.105.

MEASURING LAND BY WEIGHT.

The area of any piece of land, no matter how irregular the boundary lines, may be accurately ascertained by means of a delicate balance as follows. Make a drawing of the plot of ground on pasteboard, to a given scale, say four square rods to one inch. Cut from some part of the sheet of pasteboard a piece exactly one inch square, which represents one acre or four square rods. Also cut out the plot as drawn. Weigh the square and the plot. The number of times the weight of the square is contained in the weight of the plot indicates the area of the land. For example, if the square which represents one acre weighs twenty grains, and the plot weighs two hundred and forty grains, then the plot contains twelve acres.

MOLECULES.

A MOLECULE is the smallest mass into which any substance can be subdivided without changing its chemical nature.

All substances are aggregations of isolated molecules.

A piece of gold having six plane surfaces, each one inch square, is called a cubic inch of gold, and looks as if it solidly filled that space. But it is not solid, for it is composed of individual molecules, which are separated by comparatively wide intervals.

Molecules are, to use the language of Sir William Thompson, "pieces of matter of measurable dimensions, with shape, motion, and laws of action." A molecule of glass, as measured by this philosopher, is one five hundred millionth part of an inch in diameter.

Equal volumes of all substances, when in a state of gas, and under like conditions, contain the same number of molecules.

The number of molecules in a cubic inch of any perfect gas, at 32° F. and 30 ins. barometer pressure, is one hundred thousand millions of millions of millions, or 10^{23} .

The molecules of bodies are never at rest, but have a constant motion. The molecules of a gas confined in a vessel have great energy, are always flying about with a high velocity, but in straight lines. They strike against each other and rebound; they drive against the inner walls of the vessel, and the force of this impact of the molecules of the gas against the walls we call the pressure of a gas.

At a barometer pressure of 30 inches, or 15 lbs. to the square inch, temperature 32° F., the molecules of hydrogen have a velocity of 6097 feet per second, or over 4000 miles per hour. The energy of a pound of hydrogen, under the above conditions, is equal to that of a cannon-ball of the same weight having the same velocity.

A cubic inch of water may by heat be expanded into gaseous form, or steam, occupying the space of a cubic foot. In both forms the same number of molecules

of water are found ; but in the gaseous condition, the molecules are much more widely separated than in the liquid ; so widely, in fact, that a cubic foot of alcohol vapor together with a cubic foot of ether vapor may be introduced into the vessel—or, apparently, just as much of the alcohol, and just as much of the ether, as if there were no water vapor present. All these vapors remain separate ; they do not chemically unite.

HOW TO INVENT.

IN order to succeed, a new invention must be superior to any thing that has preceded it, and must be sold at a price that will enable it to be brought into general use.

People can not afford to throw away old implements unless the new ones are sufficiently superior to make up for the loss. Let inventors produce a good article, at a moderate price, and they will be sure of success.

The readiest way to invent is to *keep thinking* ; and to thought add *practical experiments*. Book knowledge is not essential. Examine things about you, note how they are made, and study how to improve them. Keep your eyes and ears open, ask questions, be a continual seeker after useful information. Those who do this, soon acquire a knowledge of the sciences, and insensibly become educated. Among the beneficent influences of the Patent laws is the fact that they incite the humblest individuals to study.

To avoid waste of time in reproducing old devices, the inventor should be well posted in regard to inventions that have already been made. He should also be informed as to the particular classes of devices in which improvements are most urgently demanded. For this purpose, an attentive study of THE SCIENTIFIC AMERICAN will be almost indispensable. This splendid newspaper is published weekly, and furnishes the latest information concerning the progress of new discovery, with elegant engravings. \$3.20 a year. MUNN & Co., 37 Park Row, publishers. Send 10 cents for a specimen copy.

HISTORY OF THE STEAM-ENGINE.

PAPIN, of France, was the first (in 1690) to operate a piston by steam, which acted only on one side of the piston. He also invented the safety-valve. He was born 1650, died 1710. Savery, 1697, first employed steam-power in doing useful work. His piston, like Papin's, took steam on one side only, the pressure of the atmosphere being admitted to the other side. James Watt was the first to make the complete steam-engine, or the existing forms in which steam acts on both sides of the piston. He also made the steam-condenser, the governor, the walking-beam, applied the fly-wheel, and nearly all the parts of the modern engine. He was born 1736, died 1819. He made a rotary steam engine in 1782, and patented a locomotive engine in 1784. In 1804, Trevithick and Vivian operated a locomotive which traveled five miles an hour, with a load of ten tons. Cook, in 1808, used fixed engines and ropes to draw railway-cars. Blachett and Hedley, in 1813, discovered that smooth locomotive wheels might be used on railways, instead of toothed wheels and toothed rails before required. George Stephenson, 1825, made railway locomotion successful by adapting the locomotive to variable speeds and loads, by means of his blast-pipe, and by introducing the tubular boiler, which latter was suggested to him and invented by Booth, 1829. October 6th, 1829, the famous competitive trial of locomotives on the Liverpool and Manchester railway took place, which established the superiority of Stephenson's locomotives, and inaugurated the art of railway communication.

The first steamboat actually employed in business was a small vessel built by John Fitch of Pennsylvania, 1790, worked on the Delaware; speed, $7\frac{1}{2}$ miles per hour. Robert Fulton's steamboat, the Clermont, made her first trip from New-York to Albany, August, 1807; speed, five miles per hour. The first steam-vessel to cross the Atlantic was the Savannah, in 1819, from Savannah to Liverpool, 26 days. In 1838 the Sirius arrived at New-York, 17 days from London; and the Great Western, 15 days from Bristol.

HEAT.—ITS MECHANICAL EQUIVALENT.

HEAT is a peculiar motion of the particles of matter which prevents their contact. Heat and mechanical power are convertible forces. The force of the heat that raises one pound of water 1° F. will lift a weight of 772 lbs. one foot high. The power of a weight of 772 lbs. descending one foot, if applied to a small paddle-wheel turning in one pound of water, will, by friction, raise the temperature of the water 1° F.

A *heat-unit* is the amount of heat that raises a pound of water 1° F., or that lifts a weight of 772 lbs. one foot high.

The *mechanical equivalent* of a heat-unit is the power of a weight of 772 lbs. descending one foot, or of a one-pound weight descending 772 feet. Hence,

$$\begin{aligned} 772 \text{ foot-pounds} &= 1 \text{ heat-unit,} \\ 1 \text{ heat-unit} &= 772 \text{ foot-pounds.} \end{aligned}$$

A galvanic battery that produces an electrical current capable of heating one pound of water 1° F., will yield magnetic force sufficient to raise a weight of 772 lbs. one foot high.

Thus heat, electricity, magnetism, and chemical force are brought into numerical correlation with mechanical power.

The illustrious philosopher, Dr. J. P. Joule, of Manchester, England, first promulgated the mechanical equivalent of heat, A.D. 1845.

COPYING-INK.

TAKE two gallons of rain-water, and put into it $\frac{1}{2}$ pound of gum arabic, $\frac{1}{2}$ pound brown sugar, $\frac{1}{2}$ pound clean copperas, $\frac{1}{2}$ pound powdered nut-galls. Mix and shake occasionally for ten days, and strain. If needed sooner, let it steep in an iron kettle until the strength is obtained.

VELOCITY AND FORCE OF THE WIND.

MILES PER HOUR.	FEET PER MINUTE.	PRESSURE ON A SQUARE FOOT IN POUNDS.	DESCRIPTION OF THE WIND.
1	88	.005	Barely observable.
2	176	.02	{ Just perceptible.
3	264	.045	
4	352	.08	Light breeze.
5	440	.125	{ Gentle, pleasant wind.
6	528	.18	
8	704	.32	
10	880	.5	Fresh breeze.
15	1320	1.125	Brisk blow.
20	1760	2.	Stiff breeze.
25	2200	3.125	Very brisk.
30	2640	4.5	{ High wind.
35	3080	6.125	
40	3520	8.	Very high wind.
45	3960	10.125	Gale.
50	4400	12.5	Storm.
60	5280	18.	Great storm.
80	7040	32.	Hurricane.
100	8800	50.	Tornado.

GUNPOWDER.

THE heat developed at the moment of explosion is 4664° Fahr., and the resulting gas pressure, if the powder closely fills the chamber, is 40 tons or 80,000 lbs. to the square inch.

Careful experiment by De Saint Robert with rifled cannon of 3½ inches bore, 8½ lbs. shell, 1½ lbs. powder, gives 1300 ft. velocity per second, or a little over 900 miles per hour, for the shell when it leaves the mouth of the cannon, which is equal to a force of 219,000 foot-pounds, or a little less than seven horse-power. But the heat actually developed by the above amount of powder corresponds to almost thirty-two horse-power of work; seventy-nine per cent of the power of the powder is therefore lost.

SPECIFIC GRAVITY AND WEIGHT OF VARIOUS SUBSTANCES. WATER = 1.

	Specific gravity.	Weight per cubic foot, lbs.	Weight per cubic inch, lbs.
Acetic acid.....	1.06	66.	.038
Alcohol.....	.792	49.	.028
Aluminium, sheet.....	2.67	166.6	.096
Antimony, cast.....	6.72	419.5	.249
Ash, dry.....	.69	43.	.025
" green.....	.76	47.	.027
Asphalt.....	2.5	166.	.09
Basalt.....	2.95	184.	.106
Beech, dry.....	.69	43.	.025
Bell-metal.....	6.05	502.59	.29
Birch.....	.69	43.	.025
Bismuth, cast.....	9.822	613.1	.353
Box.....	1.23	80.	.046
Brass, cast.....	8.4	524.37	.3
" sheet.....	8.44	526.86	.301
Brick, common.....	1.6	100.	.09
" { from	2.	125.	.057
" to			
Cedar, American.....	.554	35.	.020
" Lebanon.....	.486	30.	.017
" West-Indian.....	.748	48.	.026
" Indian.....	1.315	82.15	
Coment, Portland.....	1.4	87.	.05
" Roman.....	1.8	100.	.057
Chalk.....	2.33	145.	.084
Chestnut.....	.606	38.	.022
Clay.....	1.9	119.	.068
Coal, anthracite.....	1.53	95.	.055
" bituminous.....	1.27	79.	.045
Coke.....	.744	46.	.026
Concrete, ordinary.....	1.9	119.	.068
" in cement.....	2.2	137.	.079
Cork.....	.240	15.	.008
Copper, cast.....	8.607	537.3	.31
" sheet.....	8.78	543.1	.318
Deal, Norway.....	.689	43.	.025
Earth.....	1.52	77.	.054
" { from	2.00	125.	.072
" to			
Ebony.....	1.187	74.	.043
Elm.....	.579	36.	.021
" Canadian.....	.725	45.	.026
Ether.....	.716	45.	.026
Fir, spruce.....	.512	39.	.018
Firestone.....	1.8	112.	.065
Glass, flint.....	3.078	192.	.111
" crown.....	2.52	157.	.091
" common green.....	2.52	158.	.091
" plate.....	2.76	172.	.099
Gold.....	19.36	208.5	.627
Granite.....	2.65	165.75	.096
Gun metal [10 cop., 1 tin].....	8.551	534.49	.308
Gutta-percha.....	.966	60.	.035
Gypsum.....	2.286	143.	.082
Hornbeam.....	.76	47.	.027
Hydrochloric acid.....	1.2	75.	.043
Iron, cast, average.....	7.23	451.	.26
" wrought, average.....	7.78	485.6	.28
Ironwood.....	1.15	71.	.041
India-rubber.....	.93	58.	.033

The specific gravity of any liquid or solid body is its weight as compared with an equal volume of pure water at 60° F. Water = 1.

The specific gravity of a gas is its weight as compared with an equal volume of pure air at 60° F. Air = 1.

SPECIFIC GRAVITY OF GASES.

Air = 1,

Hydrogen.....	0.0692
Steam.....	0.4882
Marsh gas.....	0.5595
Carbonic oxide.....	0.967
Nitrogen.....	0.9713
Oxygen.....	1.1057
Carbonic acid.....	1.529
Sulphurous acid.....	2.25
Chlorine.....	2.47

SPECIFIC HEAT.

If 1 lb. of water, 1 lb. of mercury, 1 lb. of silver, 1 lb. of iron be exposed to a heat sufficient to raise the water 1° F., the temperature of the mercury will be found to be 80°, the silver 17.5°, the iron 8.8°. The specific heat of different substances is found by comparing their temperature with water as above. Thus, the specific heat of water is 1; the specific heat of mercury is $\frac{1}{80}$, or one-thirtieth that of water; silver, $\frac{1}{17.5}$, iron, $\frac{1}{8.8}$.

FRICTION.

A bag of wheat weighing 200 lbs. is dragged on the floor by means of a spring-balance, the pointer of which indicates 40 lbs. as the force required to move the bag. Make that force, 40, the numerator of a fraction, and the moved weight, 200, the denominator. Then $\frac{40}{200}$ or $\frac{1}{5}$ of the weight is the co-efficient of friction, or the force required to overcome the friction, $\frac{1}{5}$ of 200 lbs. is 40 lbs., which is the force indicated in this example to overcome the friction of the bag. If the load or weight were 400 lbs., and the co-efficient of friction $\frac{1}{5}$, then it would take $\frac{1}{5}$ of 400 lbs., or 100 lbs. force, to move the load.

SPECIFIC GRAVITY AND WEIGHT OF VARIOUS SUBSTANCES. WATER = 1.

	Specific gravity.	Weight per cubic foot, lbs.	Weight per cubic inch, lbs.
Ivory.....	1.82	114.	.065
Larch.....	1.543	94.	.019
Lead, cast.....	11.36	708.5	.408
" sheet.....	11.4	711.6	.41
Lignum vitae.....	1.333		.048
Lime-wood.....	.564	35.	.09
Lime, quick.....	.843	53.	.03
Limestone.....	3.180	198.75	
Logwood.....	.913	57.06	
Mahogany, Honduras... ..	.660	35.	.09
" Nassau.....	.668	42.	.094
" Spanish.....	.852	53.	.081
Maple.....	.675	42.	.095
Marble.....	2.72	170.	.098
Mercury.....	13.596	848.75	.489
Mortar, average.....	1.7	106.	.061
Muriatic acid.....	1.2	75.	
Nitric acid.....	1.217	75.	.044
Oak, African.....	.989	62.	.035
" American, red.....	.85	53.	.03
" " white, dry.....	.779	49.	.028
" Canadian.....	.872	54.5	
" English, white, dry.....	.777	48.	.028
" " green.....	.934	58.	.034
" live, seasoned.....	1.066	66.75	
" " green.....	1.260	78.75	
Oil, linseed.....	.94	58.	.034
" olive.....	.915	57.	.033
" whale.....	.923	58.	.033
Oolite, Portland stone..	2.423	151.	.087
" Bath stone.....	1.978	123.	.072
Pine, red, dry.....	.590	37.	.022
" white, dry.....	.554	34.69	
" yellow, dry.....	.461	28.81	
" pitch.....	.660	41.25	
Pitch.....	1.15	69.	.041
Platinum, average.....	21.531	1343.9	.775
Plumbago.....	2.267	140.	.082
Salt.....	2.13	133.	
Sand, quartz.....	2.75	171.	.099
" river.....	1.88	117.	.067
" fine.....	1.52	95.	.054
" coarse.....	1.61	100.	.058
Sandstone.....			
Satinwood.....	.96	60.	.034
Silver.....	10.474	653.8	.377
Slate.....	2.89	180.	.104
Sulphur.....			
Sulphuric acid.....	1.84	115.	.066
Tallow.....	.94	59.	.034
Tar.....	1.01	63.	.026
Teakwood.....	.806	50.	.028
Tile, average.....	1.83	113.50	.065
Tin, cast.....	7.29	45.51	.262
Water, distilled, 39°.....	1.000	62.428	.036
" sea.....	1.027	64.	.037
White metal (Babbitt)... ..	7.31	456.32	.263
Zinc, cast.....	7.	437.	.252

Iron bars, one inch square, rolled, weigh 3.38 lbs. per foot; round bars, one inch diameter, 2.65 lbs. per foot.

From 300 to 324 cubic feet of dry clover, or 216 to 243 cubic feet of dry hay, weigh a ton. 270 cubic feet of new hay in a ton.

In this country the average weight of men is 141 1-2 lbs.; women, 124 1-2 lbs.

The weight of horses in this country is from 800 to 1200 lbs.

The standard weight of a bushel of wheat is 60 lbs.; corn and rye, 56 lbs.; oats, 32 lbs.; barley, 49 lbs.

Potatoes, in weight 100 lbs., are made up of 75.9 lbs. water; albumen, 2.3 lbs.; oily matter, 0.3 lbs.; woody fibre, 0.4 lbs.; starch, 20.2 lbs.; minerals, 1 lb.

A kind of tracing paper, which is transparent only temporarily, is made by dissolving castor-oil in absolute alcohol and applying the liquid to the paper with a sponge. The alcohol speedily evaporates, leaving the paper dry. After the tracing is made, the paper is immersed in absolute alcohol, which removes the oil, restoring the sheet to its original opacity.

The diameter of a barrel at the heads is 17 inches; bung, 19 inches; length, 23 inches; volume, 7689 cubic inches.

INCUBATION.—The temperature of hatching eggs is 104° F. Periods: swan, 42 days; parrot, 40; goose and pheasant, 35; duck, turkey, penfowl, 28; hens, 21; pigeons, 14; canary birds, 14.

PERIODS OF GESTATION.—Gul-neapig, 3 weeks; sow, 16 weeks; cat, 8 weeks; dog, 9 weeks; lion, 5 months; sheep, 5 months; cow, 9 months; horse and ass, 11 months; buffalo and camel, 12 months; elephant, 23 months.

SMALL STEAMBOATS.

THE following is an example of the practical way in which special questions put by subscribers to the *Scientific American* are answered by the editors :

"H. C. E. says : 1. I have a boat, 21 feet long by 7 feet 6 inches beam, drawing 12 or 15 inches of water. I built an engine 3x5 inches, with a link motion. Is the engine large enough for the boat? A. Yes. 2. I have a $\frac{1}{4}$ -inch feed-pipe and $\frac{3}{4}$ -inch exhaust. Is the exhaust too small for the engine? A. It will answer very well. 3. What size of propeller should I use? A. Of 18 or 20 inches diameter, $2\frac{1}{4}$ feet pitch. 4. What size of boiler is required? A. About $2\frac{1}{4}$ feet diameter, 4 feet high. 5. What is meant by the pitch of a propeller? A. It is the distance it would move the boat, at each revolution, if it worked in an unyielding medium, like a screw in a nut."

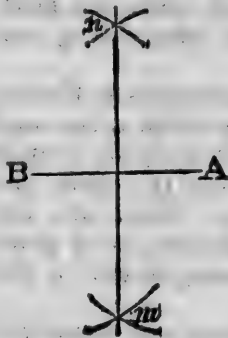
The foregoing is an epitome of dimensions sufficient to enable any intelligent machinist to build a fast and serviceable steamer. Hundreds of these little vessels are now in use throughout the country, upon the smaller lakes and shallow streams. Their use has become greatly extended by the publication of practical details of construction and management in the *Scientific American*.

Queries relating to steam engineering are answered in the *Scientific American* by an experienced engineer; those pertaining to electricity, by a practical electrician; chemical inquiries, by a superior chemist; mechanical questions, by a talented machinist; astronomical inquiries, by an astronomer; and so on, for nearly all of the departments of science. The amount of valuable information thus made public through the columns of the *Scientific American* is very large. It is, on this account, the most positively valuable weekly newspaper ever published.

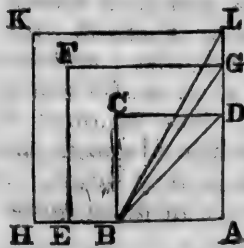
COPPER, if suddenly cooled, becomes soft and malleable; if slowly cooled it hardens and becomes brittle.

PRACTICAL GEOMETRY.

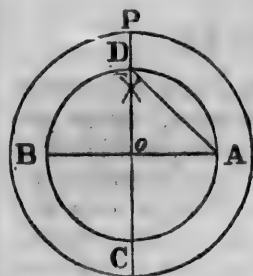
A KNOWLEDGE of geometry, both practical and theoretical, is of importance to mechanics and inventors. It is promotive of truth and patience in mental habits, and leads to the exercise of nicety and exactness in the execution of mechanical labors. With a pair of dividers, a rule and pencil, any person may speedily acquire a considerable knowledge of practical geometry. We subjoin a few simple and generally useful problems for practice, in the hope of thus interesting some of our readers in the subject, so that they will continue the study. Complete works on geometry can be had at the book-stores.



Problem 1.—To divide a line into equal parts.—To draw a line perpendicular to another: With a pair of dividers from the extremities of the line AB as centres, with any distance exceeding the point where the line is to be intersected, describe arcs cutting each other as mn ; then a line drawn through mn will divide the line AB equally, and will also be perpendicular thereto.

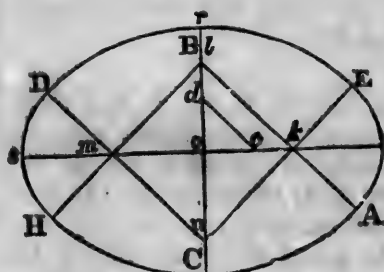


Problem 2.—To find the side of a square that shall be any number of times the area of a given square: Let $ABCD$ be the given square; then will the diagonal BD be the side of a square $AEBF$, double in area to the given square $ABCD$; the diagonal BD is equal to the line AG ; if the diagonal be drawn from B to G , it will be the side of a square $AHBK$, three times the area of the square $ABCD$; the diagonal BL will equal the side of a square four times the area of the square $ABCD$, etc.



Problem 3.—To find the diameter of a circle that shall be any number of times the area of a given circle: Let A B C D be the given circle; draw the two diameters A B and C D at right angles to each other, and the cord A D will be the radius of the circle o P, twice the area of the given circle nearly; and half the cord will

be the radius of a circle that will contain half the area, etc.



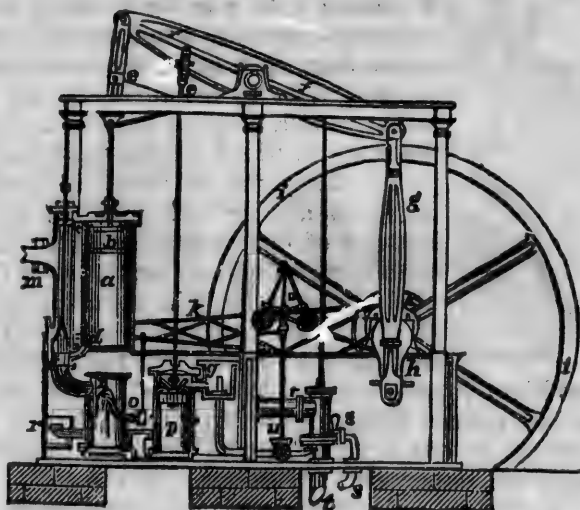
Problem 4.—To describe an ellipsis, the transverse and conjugate diameters being given: From o, as a centre, with the difference of the transverse and conjugate semi-diameters, set off o c and o d; draw the diagonal c d, and continue

the line o c to k, by the addition of half the diagonal c d, then will the distance o k be the radius of the centres that will describe the ellipsis; draw the lines A B, C D, C E, and B H, cutting the semi-diameters of the ellipsis in the centres k B m n; then with the radius m s, and with k, and m as centres, describe the arcs D H and A E; also, with the radius n r, and with n and B as centres, describe the arcs E H and A H, and the figure A E D H will be the ellipsis required.

THE "SCIENTIFIC AMERICAN."—"It is hardly necessary for us to speak of its merits to those who are thoroughly posted up in the improvements of the age; but the general reading public may not be so well aware that it contains the finest engravings of all the late inventions—the new monitors, army and navy weapons, vessels, forts, machinery of all kinds, military and civil, mechanical and agricultural—with essays from the most distinguished scholars.

THE STEAM-ENGINE.

EVERY mechanic and inventor should make himself generally familiar with the construction and operation of the steam-engine. To assist them in gaining this knowledge, we subjoin for reference a diagram of the common Condensing Engine, with letters of reference to the names of the various parts :



a, steam cylinder ; *b*, piston ; *c*, upper steam port or passage ; *d*, lower steam port ; *e e*, parallel motion ; *f f*, beam ; *g*, connecting rod ; *h*, crank ; *i i*, fly-wheel ; *k k*, eccentric and its rod for working the steam-valve ; *l*, steam-valve and casing ; *m*, throttle-valve ; *n*, condenser ; *o*, injection-cock ; *p*, air-pump ; *q*, hot well ; *r*, shifting-valve to create vacuum in condenser previous to starting the engine ; *s*, feed-pump to supply boilers ; *t*, cold-water pump to supply condenser ; *u*, governor. A study of the above diagram and description, in connection with attentive observation of engines in motion, will be of much assistance in acquiring a general understanding of the machine. We recommend the follow-

ing standard works for careful study by all who desire to become thoroughly posted: Bourne's Catechism of the Steam-Engine, Main & Brown's Marine Steam-Engine.

[From The Scientific American.]

A HINT TO LETTER-WRITING BORES.



WE consider, as a general thing, that our correspondents are a fair and high-minded set of men, such as we are most happy to accommodate by answering, so far as it is in our power, all their inquiries; but there are a few of whom we can very justly complain. They put to us all sorts of questions, to answer which might require a half-day of our valuable time; and if we snub them off with a short answer, they are likely to reply back in complaining terms. It cannot be reasonably expected of us, that we shall spend our time in such—to us—profitless letter-writing. We mean to be accommodating, but cannot consent to waste all our time in getting information for correspondents who seem not to know how to appreciate either our forbearance or the value of our time. As an example of what we mean, we have a case before us. A correspondent wants us to hunt through our files for a notice of some book which appeared in THE SCIENTIFIC AMERICAN some years ago, and to help him to find the book. He also wants us to find for him an English book which we do not believe can be had in this market. Another correspondent wants us to send to England without delay to get something which would require time and money to procure for him, but in regard to which he don't even inclose a three-cent stamp to pre-pay our letter. Another incloses three cents, and wants a calculation made which would cost us two hours' hard study. It is well enough for such correspondents to know that our time is worth to us more than a cent and a half per hour. Treat us fairly, and you will have no cause of complaint.

TABLE OF OCCUPATIONS,

COMPILED FROM THE LAST CENSUS OF THE UNITED STATES, A.D. 1870.

All occupations (persons engaged in).....12,505,923		PROFESSIONAL AND PERSONAL.	
AGRICULTURE.....total, 5,922,471		Domestic servants.....	975,734
Agricultural laborers.....	2,885,996	Employees of companies (not specified).....	848
Appliarists.....	136	Employees of Government.....	14,407
Dairymen and dairywomen, Farm and plantation overseers.....	3,550	Employees of hotels and restaurants.....	23,438
Florists.....	3,609	Engineers, civil.....	4,708
Farmers and planters.....	2,977,711	Hostlers.....	17,536
Gardeners and nurserymen, Stock-drovers.....	1,085	Hotel-keepers.....	26,394
Stock-herders.....	31,435	Hunters and trappers.....	940
Stock-raisers.....	3,181	Indian guides and interpreters.....	171
Turpentine farmers.....	5,590	Intelligence-office keepers..	191
Turpentine laborers.....	6,588	Inventors.....	35
Vinegrowers.....	861	Janitors.....	1,769
	2,117	Journalists.....	5,283
	1,112	Laborers (not specified)....	1,081,656
		Lamp-lighters.....	276
		Land-surveyors.....	2,671
		Launderers & laundresses..	60,906
PROFESSIONAL AND PERSONAL SERVICES.....	2,684,793	Lawyers.....	40,736
Actors.....	2,053	Librarians.....	213
Apprentices to learned professions.....	386	Livery-stable keepers.....	8,504
Apprentices to barbers.....	859	Marines (U. S.).....	477
Apprentices to dentists....	166	Messengers.....	3,717
Architects.....	2,017	Metallurgists.....	164
Artists (not specified).....	2,948	Midwives.....	1,185
Auctioneers.....	2,266	Musicians (professional)...	6,519
Authors and lecturers.....	458	Naturalists.....	287
Barbers and hairdressers...	23,935	Nurses.....	10,976
Bath-house keepers.....	94	Officers of the Army and Navy.....	2,283
Billiard and bowling-saloon keepers.....	1,220	Officials of companies (not specified).....	3,410
Bill-posters.....	424	Officials of Government....	44,743
Boarding and lodging-house keepers.....	12,785	Painters.....	775
Boot-blacks.....	587	Physicians and surgeons...	62,338
Card-writers.....	33	Restaurant-keepers.....	35,135
Chemists (practicing).....	608	Sailors (U. S. Navy).....	780
Chimney-sweeps.....	73	Scavengers.....	301
Chiropodists.....	66	Sculptors.....	250
Claime agents.....	693	Sextons.....	1,151
Clergymen.....	43,874	Short-hand writers.....	154
Clerks and copyists.....	6,138	Showmen and showwomen,	1,177
Clerks in Governm't offices,	8,672	Soldiers (U. S. A.).....	22,081
Clerks in hotels and restaurants.....	5,243	Teachers (not specified)....	126,822
Dentists.....	7,839	Teachers of dancing.....	149
Designers and draughtsmen.....	934	Teachers of drawing and painting.....	108
		Teachers of music.....	9,491
		Translators.....	21
		Veterinary surgeons.....	1,166
		Whitewashers.....	2,873

TABLE OF OCCUPATIONS. (Continued.)

TRADE AND TRANSPORTATION.		TRADE AND TRANSPORTATION.	
TRADE AND TRANSPORTATION.....	1,191,238	Porters in stores and warehouses.....	16,631
Agents.....	10,499	Sailors.....	56,663
Apprentices in stores.....	678	Salesmen and saleswomen....	14,203
Bankers and brokers.....	10,631	Shippers and freighters....	3,567
Barkeepers.....	14,362	Steamboat men and women....	7,975
Boatmen and watermen....	21,332	Stewards and stewardesses..	1,245
Book-keepers and accountants in stores.....	81,177	Toll-gate & bridge keepers..	2,253
Canalmen.....	7,338	Traders and dealers (n.s.)...	100,406
Clerks in stores.....	222,504	Traders in agricultural implements.....	1,930
Clerks and book-keepers in banks.....	7,103	Traders in books and stationery.....	3,392
Clerks and book-keepers in express companies.....	767	Traders in boots and shoes..	7,019
Clerks and book-keepers in insurance offices.....	1,568	Traders in cabinet-ware....	4,087
Clerks and book-keepers in railroad offices.....	7,374	Traders in cigars & tobacco..	8,234
Clerks and book-keepers in telegraph offices.....	191	Traders in clothing.....	7,595
Commercial travelers.....	7,262	Traders in cloths and textile fabrics.....	1,163
Draymen, hackmen, teamsters, etc.....	120,756	Traders in coal.....	4,143
Employees of trading and transportation companies	4,152	Traders in coal and wood..	2,493
Employees of banks (not clerks).....	424	Traders in cotton.....	1,701
Employees of express companies (not clerks).....	8,554	Traders in crockery, china, and stoneware.....	1,765
Employees of insurance companies (not clerks)...	11,611	Traders in drugs and medicines.....	17,369
Employees of railroad companies (not clerks).....	154,027	Traders in dry-goods.....	29,790
Employees of street railroad companies (not clerks)...	5,103	Traders in gold and silver ware and jewelry....	6,402
Employees of telegraph companies (not clerks)...	8,316	Traders in groceries.....	74,410
Hucksters.....	17,362	Traders in hats and caps...	3,375
Laborers.....	14,882	Traders in ice.....	1,464
Milkmen and milkwomen..	3,728	Traders in iron, tin, and copper ware.....	2,003
Mule-packers.....	473	Traders in leather, hides, and skins.....	2,261
Newspaper criers and carriers.....	2,002	Traders in lime.....	310
Officials of trading and transportation companies	976	Traders in liquors & wines..	11,713
Officials of banks.....	2,738	Traders in live-stock.....	7,723
Officials of express co's....	75	Traders in lumber.....	9,440
Officials of insurance co's...	762	Traders in machinery (n.s.),	254
Officials of railroad co's...	1,902	Traders in music and musical instruments.....	848
Officials of street rail'd co's.	88	Traders in newspapers and periodicals.....	1,455
Officials of telegraph co's..	72	Traders in oils, paints, and turpentine.....	936
Packers.....	1,421	Traders in optical instruments.....	301
Pawnbrokers.....	334	Traders in produce.....	11,809
Peddlers.....	16,975	Traders in provisions.....	7,528
Pilots.....	3,649	Traders in real estate.....	8,933
		Traders in sewing-machines,	3,152
		Undertakers.....	1,996
		Weighters, gaugers, and measurers.....	926
		Wreckers.....	93

TABLE OF OCCUPATIONS. (Continued.)

MANUFACTURES AND MINING.....		MANUFACTURES AND MINING.	
	2,707,421	Daguerreotypists and photographers.....	7,553
Agricultural-implement makers.....	8,811	Die-sinkers & stamp-makers.....	479
Artificial-flower makers.....	1,169	Distillers and rectifiers.....	2,874
Apprentices (not specified).....	15,302	Employees.....	20,242
Bag-makers.....	866	Engineers and firemen.....	34,333
Bakers.....	27,630	Engravers.....	4,226
Basket-makers.....	3,297	Fertilizer-establishment operatives.....	316
Bell-founders.....	169	File makers, cutters, and grinders.....	1,413
Belting-factory operatives.....	296	Fire-works-makers.....	101
Blacksmiths.....	141,774	Fishermen and oystermen.....	27,106
Bleachers, dyers, and scourers.....	4,901	Flax-dressers.....	1,046
Blind, door, and sash makers.....	5,155	Fur-workers.....	1,191
Boat-makers.....	2,101	Galloon, glimp, and tassel makers.....	569
Bone and ivory workers.....	208	Gas-works employees.....	2,086
Bookbinders and finishers.....	9,104	Gilders.....	1,534
Boot and shoe makers.....	171,127	Glass-works operatives.....	9,618
Box-factory operatives.....	6,080	Glove-makers.....	2,329
Brass founders and workers.....	4,694	Glue-makers.....	241
Brewers and maltsters.....	11,246	Gold and silver workers.....	18,508
Brick and tile makers.....	26,070	Gun and lock smiths.....	8,184
Bridge builders and contractors.....	1,029	Hair cleaners and dressers.....	1,026
Britannia and japanned ware makers.....	1,092	Harness and saddle makers.....	32,517
Broom and brush makers.....	5,816	Hat and cap makers.....	12,625
Bronze-workers.....	79	Hoop-skirt makers.....	962
Builders and contractors (not specified).....	7,511	Hose-makers (leather and other).....	248
Butchers.....	44,354	House builders and contractors.....	399
Button-factory operatives.....	1,272	Ice-cutters.....	142
Cabinet-makers.....	42,835	Ink-makers.....	78
Candle, soap, and tallow makers.....	1,942	Iron and steel works and shops operatives.....	22,141
Card and fancy-paper makers.....	339	Iron-foundry operatives.....	34,245
Car-makers.....	2,228	Iron-furnace operatives.....	7,452
Carpenters and joiners.....	344,596	Iron and steel rolling-mill operatives.....	17,249
Carpet-bag and satchel makers.....	202	Knitting and hosiery mill operatives.....	3,053
Carpet-makers.....	15,669	Linen-mill operatives.....	706
Carriage and wagon makers.....	42,464	Lumbermen and raftsmen.....	17,752
Charcoal and lime burners.....	3,834	Macaroni and vermicelli makers.....	29
Cheese-makers.....	3,534	Machinists.....	54,755
Cigar-makers.....	28,286	Manufacturers.....	42,877
Clerks and book-keepers.....	5,861	Marble and stone cutters.....	25,831
Clock-makers.....	1,779	Masons, brick and stone.....	89,710
Comb-makers.....	693	Mast, spar, oar, and block makers.....	653
Confectioners.....	8,219	Mattress-makers.....	375
Coopers.....	41,789	Meat and fruit preserving employees.....	770
Copper-workers.....	2,122	Meat packers, curers, and picklers.....	1,164
Cotton-mill operatives.....	111,606		
Curriers, tanners, finishers of leather.....	28,702		

TABLE OF OCCUPATIONS. (Continued.)

MANUFACTURES AND MINING.		MANUFACTURES AND MINING.	
Mechanics (not specified)...	16,514	Rope and cordage makers..	2,075
Mill and factory operatives (not specified).....	41,619	Rubber-factory operatives..	3,886
Millers.....	41,682	Sail and awning makers....	2,309
Milliners, dress and mantua makers.....	92,084	Salt-makers.....	1,721
Mineral-water makers.....	458	Saw-mill operatives.....	47,298
Miners.....	153,107	Sawyers.....	6,939
Mirror and picture frame makers.....	970	Scale and rule makers.....	416
Morocco-dressers.....	1,728	Screw-makers.....	780
Musical instrument makers (not specified).....	377	Sewing-machine factory operatives.....	3,981
Needle-makers.....	164	Sewing-machine operators..	3,042
Officials of manufacturing companies.....	2,144	Shingle and lath makers...	8,788
Officials of mining compa- nies.....	576	Ship-carpenters.....	15,900
Oil-cloth makers.....	454	Ship-smiths.....	396
Oil-refinery operatives.....	1,747	Ship-calkers.....	3,068
Oil-well operators & labor's,	8,803	Ship-riggers.....	1,057
Organ-makers.....	667	Shirt, cuff, & collar makers,	4,080
Oyster-packers.....	448	Shot, cartridge, and fuse makers.....	186
Painters and varnishers....	85,128	Silk-mill operatives.....	3,256
Paper-hangers.....	2,490	Spring and axle makers....	301
Paper-mill operatives.....	12,469	Starch-makers.....	229
Patent-medicine makers...	409	Stave, shook, and heading makers.....	1,858
Pattern-makers.....	3,970	Steam-boiler makers.....	6,958
Perfumers.....	248	Steam-engine makers.....	4,172
Plano-forte makers.....	2,585	Stereotypers.....	853
Plasterers.....	23,577	Stove, furnace, and grate makers.....	1,543
Plaster-moulders.....	223	Straw-workers.....	2,020
Plate-printers.....	231	Sugar makers and refiners..	1,609
Plumbers and gasfitters....	11,148	Tailors, tailoresses, and seamstresses.....	161,820
Potters.....	5,060	Tinners.....	30,524
Powder-makers.....	575	Tool and cutlery makers...	5,351
Printers.....	89,860	Trunk and valise makers...	1,845
Print-works operatives.....	3,788	Tobacco-factory operatives,	11,985
Publishers of books, maps, newspapers.....	1,577	Truss-makers.....	74
Pump-makers.....	1,672	Type foundries and cutters,	649
Quarrymen.....	13,589	Umbrella & parasol makers,	1,439
Quartz & stamp mill labor's,	617	Upholsterers.....	5,736
Rag-pickers.....	436	Wheelwrights.....	20,942
Railroad builders and con- tractors.....	1,292	Whip-makers.....	609
Reed and shuttle makers...	200	Window-shade makers....	245
Roofers and slaters.....	2,750	Wire makers and workers..	1,834
		Woodchoppers.....	8,398
		Wood turners and carvers..	7,947
		Woolen-mill operatives....	58,836

GENERAL SUMMARY.

Engaged in agriculture.....	5,922,471
" " professional service.....	2,684,793
" " trade and transportation.....	1,191,238
" " manufactures and mining.....	2,707,421

All occupations 1870, persons in.....12,505,923

LIGHTNING RODS.

THE golden rule of safety is to provide the building with plenty of rods or conductors, and make sure that their lower ends, in the ground, are soldered to a *large surface* of metal or other conducting material placed underground. The common method is simply to stick the end of the rod three feet down into dry earth. But this is unsafe, because dry earth is a very poor conductor of electricity. To compensate for this lack of conductivity, the bottom of the rod should communicate with a large extent of conducting material. This may be done by soldering the lower end of the rod to water or gas pipes, if they exist; if not, then dig a trench four feet deep, six inches wide at bottom, in which deposit a layer six inches thick of coal dust, charcoal, anthracite, or bituminous. Bed the end of the rod for several feet in this layer of coal, which is a pretty good conductor of electricity. The trench should be one hundred or more feet in length. The rods should be placed on all ridges, corners, and chimneys. All metallic roofs, gutters, and water-pipes should have soldered connection with the rod, which should not be insulated from the building. All metallic water, gas, stove, and other pipes within the building, all bell wires, masses of metal, machinery, should be connected with the ground, in the manner described for the rods. The more conductors that are connected with the ground in this way, the greater the safety. Common one half inch square iron makes a good conductor. So does copper wire one eighth inch in diameter.

UNDERDRAINING.—Surface water that flows off the land instead of passing through the soil, carries with it whatever fertilizing matter it may contain, and abstracts some from the earth. If it pass down through the soil to drain, this waste is arrested.

COMMON hydraulic cement mixed with oil forms a good paint for roofs and out-buildings. It is water-proof and incombustible.

ORDINARY CONCRETE is a coarse mortar made of 1 measure of fine quicklime, $1\frac{1}{2}$ of water, 6 to 8 of gravel and broken bricks or stones. Forms a cheap foundation or wall. The ground trench being made, the concrete, well mixed, is thrown in, in layers of one foot thickness, and thoroughly compacted by rammers. Above ground, wide planks are used to form trench. If carefully mixed and rammed, durable walls may be quickly and cheaply made.

MINERAL CONSTITUENTS ABSORBED OR REMOVED FROM AN ACRE OF SOIL BY THE FOLLOWING CROPS.

	Wheat, 25 bushels.	Barley, 40 bushels.	Turnips, 20 tons.	Hay, 1½ tons.
	Lbs.	Lbs.	Lbs.	Lbs.
Potassa.....	29.6	17.5	47.1	38.2
Soda.....	3.	5.2	8.2	12.
Lime.....	12.9	17.	29.9	44.5
Magnesia.....	10.6	9.2	19.7	7.1
Oxide of Iron....	2.6	2.1	7.1	.6
Phosphoric Acid..	20.6	25.8	46.3	15.1
Sulphuric Acid..	10.6	2.7	13.3	9.2
Chlorine.....	2.	16.	3.6	4.1
Silica.....	118.1	129.5	247.8	78.2
Alumina.....	....	2.4	...	....
Total... ..	210.00	213.00	423.00	209.00

USEFUL FACTS AND RECIPES.

FREEZING MIXTURES.—A mixture of nine parts phosphate of soda, six parts nitrate of ammonia, and four parts nitric acid, is a freezing compound which will cause a fall in temperature of 71° Fahrenheit.

Equal weights of sal-ammoniac and nitre, dissolved in its own weight of water, lowers the temperature of the latter from 50° Fahrenheit to 10° or 22° below the freezing point.

SOAP-BUBBLES.—Few things amuse children more than blowing bubbles. Dissolve a quarter of an ounce of Castile or oil soap, cut up in small pieces, in three quarters of a pint of water, and boil it for two or three minutes; then add five ounces of glycerine. When cold, this fluid will produce the best and most lasting bubbles that can be blown.

LIQUID-GLUES.—Take of gum shellac three parts, caoutchouc (india-rubber) one part, by weight. Dissolve the caoutchouc and shellac in separate vessels, in ether free from alcohol, applying a gentle heat. When thoroughly dissolved mix the two solutions, and keep in a bottle tightly stoppered. This glue is called marine glue, and resists the action of water both hot and cold, and most of the acids and alkalis. Pieces of wood, leather, or other substances, joined together by it, will part at any other point than the joint thus made. If the glue be thinned by the admixture of ether, and applied as a varnish to leather, along the seams where it is sewed together, it renders the joint or seam water-tight, and almost impossible to separate.

CIRCLES.

A CIRCLE is the most capacious of all plain figures, or contains the greatest area within the same outline or perimeter.

To find the circumference of a circle, multiply the diameter by 3.1416, and the product will be the circumference.

To find the diameter of a circle, divide the circumference by 3.1416, and the quotient will be the diameter.

Any circle whose diameter is double that of another, contains four times the area or the other.

To find the area of an ellipsis, multiply the long diameter by the short diameter and by .7854; the product will be the area.

To find the area of a circle, multiply the square of the diameter by the decimal .7854. Or multiply the circumference by the radius, and divide the product by 2.

PLASTER OF PARIS may be prepared in three ways to form a hard casting capable of taking a high polish. Mixed with a solution of borax, then rebaked, powdered, and mixed with a solution of alum, it forms Parian. Mixed with solution of alum, rebaked, powdered, and mixed with alum solution, it forms Keene's cement. Mixed with solution of sulphate of potash, rebaked, powdered, and mixed with alum solution, it forms Martin's cement.

WATER is the offspring of the two gases hydrogen and oxygen. If eight pounds of hydrogen and one pound of oxygen are mixed and ignited by a flame, they combine with a violent explosion and form nine pounds of limpid water. If this water is now sufficiently heated, *e.g.* by passing it slowly through a red-hot tube, it quietly separates into its original gases—namely, eight pounds of hydrogen, one of oxygen.

Should we deal with these gases by volumes, instead of pounds, then three cubic feet of the combined gases, of which two are hydrogen, and one of oxygen, if mixed and exploded form water; but the water produced only occupies the two thousand six hundredth part of the space filled by the combined gases prior to the explosion.

THE AIR, the atmosphere we breathe, is composed of four parts of nitrogen gas and one part of oxygen. For example, if we mix four gallons of nitrogen and one of oxygen, we have five gallons of air. It is the oxygen that supports life; the nitrogen is simply a diluent or spreader.

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